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ABSTRACT

A computerized monitoring system was developed for grades 4-6. Objectives and corresponding test items were stored on computer. Instructors selected objectives for each monitoring period. Stdents were tested frequently using interchangeable forms of tests covering these objectives. Tests were computer scored and interpreted by teachers. These interpretations led to curriculum decisions as well as student feedback. After the system was implemented, student performance on both norm-referenced and criterion-referenced tests improved. (SD)

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DEVELOPMENT AND IMPLEMENTATION of COMPUTERIZED MONITORING SYSTEM In MATHEMATICS GRADES 4, 5, 6

by RAYMOND H. FOURNIER

Submitted in partial fulfillment of the requirements for the degree of Doctor of Education, Nova University.

Old Westbury Cluster

Dr. J. Borum, Coordinator

Maxi I and II

April - 1975

SE 019 543

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ABSTRACT

The purpose of this practicum was to develop and implement a computerized monitoring system for Math in grades 4, 5, and 6, (The same system, once established, can be used for monitoring Reading as well) in three years. The hypothesis is that such an implementation will improve student performance both on norm-referenced and criterion-referenced tests. The practicum was successfully executed and the hypothesis was confirmed.

INTRODUCTION

This report will detail a three year labor for the purpose of helping students perform better academically. The Needs will discuss the context prior to the establishment of this monitoring system. Section II, the Problem will detail the conflict between norm-referenced and criterion-referenced forms of education. The different views of what constitutes learning should be made evident. Section III will describe the Brentwood, New York application of Comprehensive Achievement Monitoring. The procedures, forms and systems will be explained. In Section IV there is a discussion and explanation of the material that needed to be developed to help parents, students and teachers implement and interpret the system. Section V will detail the sequences of activities required for use of the monitoring system. Section VI will deal primarily with the outcomes of the process; that is, the use of the information to modify behavior, materials and course content to help students improve performance. Section VII reports on the back-up system which provides detailed information on each objective. In Section VIII the course of implementation of this program in the Brentwood Schools is narrated. In Section IX the results in terms of student performance are reported. Section X discusses the budget from the beginning of the program to the present date.

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Maureen Belanger, Vice President
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the Superintendent of Schools, Mr. G. Guy DiPietro, The Assistant Superintendent of Schools, Dr. Arthur R. Brieger, the Principals, teachers, team leaders and aides who have all contributed toward the success and improvement of the program. However, there is one part in the Curriculum Office where all materials, Forms, Procedures and people cross. At this point, the management by Mrs. Hilda Forrest kept everything moving in the appropriate direction and contributed immeasurably to the success of the program.

Mr. Robert Howlett, Assistant Superintendent of the Half Hollow Hills School district and his staff have chosen to work out the primary program which constitutes the first half of an elementary curriculum. Mr. Howlett's cooperation in proposal development and his responsibility in executing his half are worthy of commendation.

I. Needs. Brentwood is a community in the middle of Long Island. Prior to 1950 it was sparsely settled. The extension of the Long Island Railroad plus the population explosion of the 1950's and 1960's brought rapid development. By 1970 there were more than 60,000 people in the community and 22,000 students in grades K-12. Twenty large schools had been built and yet the secondary schools were on split-session. The population of the school district, it was reported to the state, was 13% Spanish surnamed, 5% black and 82% white. The community developed as housing projects which were occupied as quickly as they could be built. Some workers commute to the city, nearly fifty miles away. However, most commute to other communities much closer. Brentwood has not developed extensive industry of its own.

Student performance on standardized tests indicated a narrow top band of achievement and wide band of sub norm performance. In 1970, on California Achievement tests and New York State Tests, it seemed clear that the trend had developed to a critical state.

1970 PEP Tests

% Below Minimum Competence

Grade	Reading	Math
3	24	19
6	31	32

The educational fundamentals of math and reading were not being successfully taught. Success was not possible in our secondary schools

The Assistant Superintendent and this writer met extensively to develop a strategy for reversing the disasterous trends revealed by the norm referenced test scores.

A series of tax increases and budget rejections had forced a depletion of the supervision staff in the Brentwood Schools. Where there had once been a full time Mathematics Coordinator and staff and a full time Reading Coordinator and staff, there were now none left. An outcome was that in this period there was a decreasing amount of supervision and monitoring of both the mathematics and reading programs. It was very clear from recent budget votes that there was no chance of hiring personnel to conduct supervision of the program. As we studied our problem and consulted other school districts, the New York State Education Department and local universities, another point of view slowly began to dominate our thinking. It seemed that new methods of monitoring instruction were beginning to evolve.

General Procedures of Monitoring[1]

Step 1. Specify the overall performance objectives to be accomplished through a given educational program. The performance objectives would complete the first task for accountability.

---

[1] Educational Accountability: A format for Monitoring the Teaching-Learning Process, Terry D. Cornell, ERIC Diversified Systems Corporation. Educational Innovations Press, Tucson, Arizona, 1971.

Step 2. Specify the time interval for monitoring. The instructors that are involved in the instructional program should agree on the interval of time that will pass between monitoring points. In most instances, the monitoring period would probably be weekly or bi-weekly.

Step 3. Select a person to be responsible for keeping a record of each instructor's sheets for each monitoring point. This person's responsibility would be to make sure that each sheet is completely filled out -- statement of objectives that will be dealt with during the monitoring interval, completion of Planned Program section at the beginning of the monitoring interval, completion of Actual Program section at the end of the monitoring interval, indication of what objectives were met and what objectives were not met.

In addition to general procedures, there are some individual instructor procedures which should be followed if this monitoring system is to provide relevant feedback. The procedures are listed in sequential order.

Individual Instructor Procedures

Step 1. Prepare interim behavioral objectives in a sequential order of accomplishment as they relate to the overall performance objective(s). The only difference

between interin objectives and the overall performance objective is that there will be a shorter time interval and the situation under which the behavior will be observed will be more specific.

Step 2. Select those objectives that will be considered for the given monitoring period.

Step 3. Complete the Planned Program as it relates to the accomplishment of the objectives identified in Step 2 above.

Step 4. At the end of the monitoring interval, complete the Actual Program section and indicate which objectives were completed and which objectives were not completed.

Step 5. Recycle by selecting the next objective(s) as identified in Step 1 above and compiete the Planned Program section on the next monitoring sheet.

Step 6. Continue process.

Almost completely from necessity through the lack of alternatives that we could afford, we were headed in the monitoring program development. Though there were some common elements in monitoring systems, objectives, items and detailed records, there were many directions that could have been pursued.

We had long felt uncomfortable working with standardized tests to evaluate our student progress. Like school administrators everywhere, we knew there were inherent weaknesses in standardized

tests. Yet, their level of acceptance is so high that they generally receive full unquestioned confidence of the tax payer despite their obvious limitations. Norm referenced tests may be characterized fairly by the following qualities:

A norm referenced test compares the performance of one individual against the performance of many other individuals. The point at which half of the group scores above and the other half scores below is the "norm". Tests are standardized so that half of the students will score above a certain point and half below. When a situation arises in which more people score above than below, for example, a test might have to be re-normed. In order to achieve this standardization items chosen for the test tend to be instruction proof. That is, if an item is taught successfully to 4th graders all over the country, it will not make a good test item for a norm referenced test because more than half of the population will score correctly.

Dependence on these teaching proof items may have contributed to another phenomenon associated with norm referenced testing. One can predict with amazing accuracy what a group of students will score on norm referenced tests if one knows the following information:

a. Income of father

b. language ability of mother

c. social-economic position in the community

For whatever reasons, in the United States the children in wealthy communities attain high scores on standardized tests and the children in poor communities attain low scores on standardized tests. This phenomenon has the status of legal acceptance in New York State. The standardized New York State tests administered in grades 3, 6 and 9 for mathematics and reading serve as the fundamental information in a booklet of Performance Expectations that the State Department published for every school district. Information concerning the district's wealth (per pupil valuation) and other socio-economic data are then combined to predict what students will score on subsequent standardized tests. In addition, in 1974 the legislature passed an act called Chapter 241 of Education Laws of New York State. This law provides that a district will be reimbursed in state aid at the ratio of 1.25 for the percentage of students scoring two more grades below level according to the New York State Test. The system is almost infallible. Wealthy districts have high scores and poor districts have low scores. A survey of the literature finds no notable large scale exceptions. All of this is prelude to the generalization that while we are required to administer norm referenced tests, those who administer them generally know that they will be of little use in organizing the instructional program. On norm referenced tests, 50% of the population must be in the sub norm position that is generally interpreted as failure in our society.

Criterion referenced tests on the other hand, are based on behavioral objectives, specific and precise statements of expectation for the performance of the learner after the specified conditions have been met. Attainment of the objective under those specified conditions constitutes "meeting the criterion". Criterion referenced tests measure the performance of an individual student against the performance specified in the objective. Another way of expressing the idea, is to say that criterion tests measure a student against the curriculum instead of comparing his performance against other students. It compares a students performance against the objective. It does not compare students to each other or to a norm.

Another facet of criterion testing is that the tests contain only items that test the stated objective they are directly related to the instructional program.

In addition, criterion referenced tests provide feedback concerning the instructional program. Since the objective stated student performance after certain conditions were met, unsuccessful performance may mean

a. further study and practice needed by student
b. prior learnings need to take place
c. conditions stated in the objective are insufficient or inappropriate to bring about the student's behavior.

Whatever the result the information given by the test is always useful

to examine student performance or the means of instruction or the test itself.

Interpretation of criterion referenced tests also varies greatly from that of norm referenced tests where a student generally passes or fails. For criterion tests, his achievement is a matching of his performance against the goal stated in the objective. Failing means that he has not yet performed as expected; passing means that he is ready for another objective. Criterion tests are locally developed to meet the needs of local students. They may be adjusted according to needs or according to student performance. They are flexible -- related to students, their goals and their needs. Since criterion tests test the objectives directly, these tests are very important in evaluating the instructional program.

Purpose for testing	Required Capability	Test Which Meets The Requirement
Placement	To test retention of knowledge and skills prerequisite to specific objectives to be taught in current courses for purpose of early relevant placement. Must pinpoint specific weaknesses.	x CRT _ NRT Readministration of "final test(s)" from prerequisite course(s).
Pretest	To test entry knowledge and skills of specific behavioral objectives to establish entry knowledge data and detect students who already have the required knowledge and skill.	x CRT _ NRT An equivalent form of the "final test" of the current course.

Placement (During Current Course)	To pinpoint specific weaknesses, particularly in hierarchical situations, in order to prescribe learning materials and situations designed to eliminate weaknesses and strengthen retention. Items must test attainment of specific behavioral objectives.	x CRT _ NRT A test composed of relevant enabling test items.
Mastery Test	To determine a students' mastery of a specific subject or operation or a major hierarchical sub-unit. May determine mastery of pre-requisite knowledges and skills or terminal objectives. Items must test specific behavioral objectives.	x CRT _ NRT A test composed of relevant terminal or subterminal items.
Posttest	To determine a students' exit knowledge in comparison, item by item, with entry knowledge in order to determine the individual students' improvement in specific subjects during the course. Items must test specific behavioral objectives.	x CRT - NRT An equivalent form of the pretest
National Ranking	To determine how a student, or group of students, rate on a scale from high to low, in relation to all students on a nation-wide basis in a subject area. Rating is plotted on the "bell shaped" curve.	_ CRT x NRT A test composed of items sampling a subject matter designed to separate students by ability or knowledge.
Aptitude Test	To sample student's aptitudes or abilities in an effort to predict (on a percentile scale) those who will do well and those who will do poorly in a particular discipline or job.	_ CRT x NRT A test of items that has shown predictable validity and reliability.

Assigning Grades	To separate students into a series of categories from good (A) to poor (F). The subject matter is sampled. Emphasis is quite often on testing in an effort to separate "A" students from "F" students.	_ CRT x NRT A test composed of items sampling previously taught subject matter.

[2]

In 1971 Dr. Brieger and I met with Dr. Robert O'Reilly, Chief of the Bureau of Research and Cultural Affairs, New York State Education Department and Dr. William Gorth, School of Education, University of Massachusetts. At this meeting we learned of a computerized monitoring system which they had developed with Dr. Pinsky in California. The computer offered the ingredients needed for our situation. (This will be discussed in detail in the section on Process of Implementation). That is, large-scale capacity for performing, scoring and clerical functions with great speed for overnight turn-around of results for teachers.

The requirements of the computer, however, were that inputs, i.e., objectives, items, tests, answers, etc. had to be precisely and exactly detailed in a preset form and sequence. It became this writers task to organize a staff of principals and teachers to

a. write and select objectives

b. develop test items for those objectives

c. develop tests

[2] Instructional Module Criterion Referenced Testing, New York State Education Department, Bureau of Research, Albany, 1971.

d. develop manuals for teachers, parents and students

e. develop cross reference guides which indicated where in the materials available in our schools, a particular objective was taught.

f. code objectives for the computer

g. arrange for programming

h. prepare teachers

i. distribute all required materials

j. coordinate testing, collection, scoring and return

k. monitoring of the monitoring program to evaluate its contribution to the educational program

It was determined that the first trial of the program would be in grades 4, 5 and 6 in mathematics. Mathematics was chosed because

a. we were in great need to improve our teaching of mathematics.

b. more work had been done with behavioral objectives and test items in mathematics than for other subjects.

c. the precision of mathematics seemed to offer greater hope for success in the first trial.

Having elected to employ a criterion-referenced testing system to monitor student progress in the Brentwood Schools, we were given the opportunity to re-examine our instructional program in terms of needs of the students and community. We did not pursue this in a

fashion that would have satisfied Dr. Stufflebeam, yet we did examine quite carefully where we stood in relation to what it was we hoped to achieve. Some of the factors we considered were:

1. Community Expectations. Brentwood parents, it was soon observed, believed in education as a way of improving financial and social standing for their children. They had not yet read Professor Jencks. [3]
2. Student Characteristics. Academically Brentwood students followed a statewide pattern. 3rd grade performance was high but declined at a faster than statewide rate at 6th grade and 9th grade level. An immediate goal became the improvement of performance on 6th grade tests to at least statewide levels.
3. Student Interests. There is a strong faith in education on the part of primary grade students. They believe they can learn and that if they learn they will succeed. This faith diminishes with age but remains strong.
4. Performance Characteristics of Graduates.
   a. 25% go to four year colleges
   b. 25% go on to two year colleges and vocational training
   c. 50% join the work force, military or marry to raise a family immediately

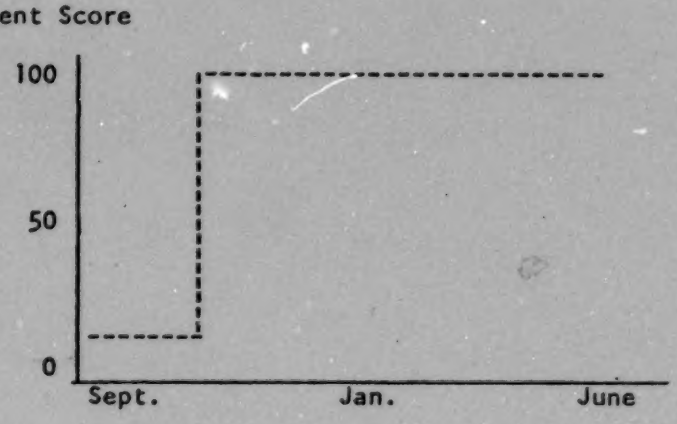
[3] Cristopher Jencks, et al., Inequality A Reassessment of the Effect of Family and Schooling in America, Basic Books, Inc, Pub., New York, 1972.

In reviewing community and student needs it became clear that there was a strong desire and need to perform well academically. The dilemma occurred because the community standard for judging success was a norm-referenced test -- The New York State Test administered at grades 3, 6, and 9. The results of this test are annually published in the local newspaper. Communities are all listed and easily matched against each other.

In addition to improved student learning demonstrated on criterion tests, we would have to achieve improved scores on standardized tests at the 6th grade level. We made this a three year goal of the program.

II. The Program.

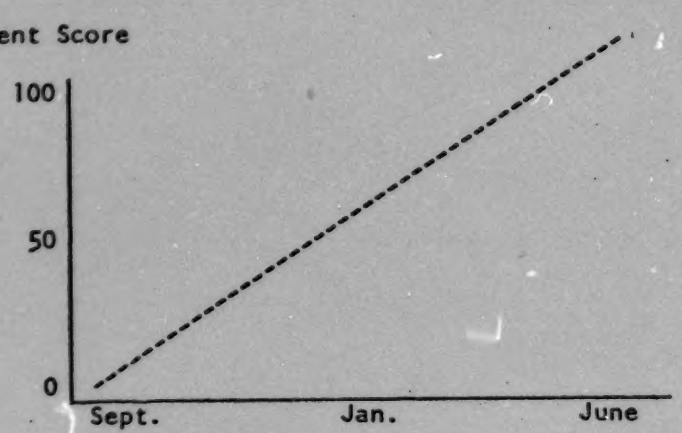
At an early meeting I heard Dr. William Gorth discuss the problem of developing useful information about student performance as one of the central issues in curriculum development and adjustment. He posed the question in terms of graphs.



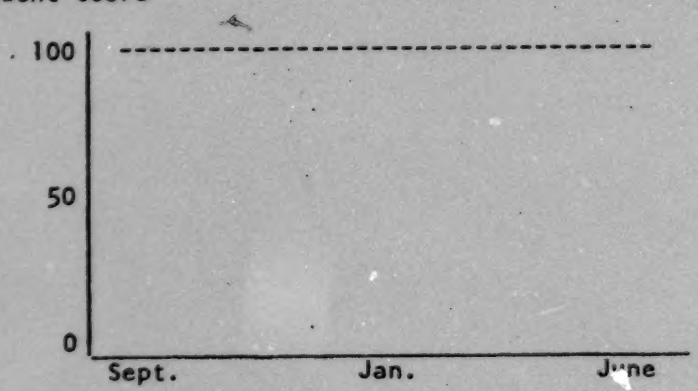
In this graph we see illustrated the situation that most of us hope for when we teach. Many teachers believe it is what actually happens. This, of course, is the ideal learning pattern in which a student comes to class not knowing what is in the course. At the starting point in September, the teacher teaches this particular unit. The student proceeds to go from near zero not knowing to near 100 knowing. Furthermore, he does not forget. He keeps on knowing overtime. This probably doesn't occur regularly in instruction but most teachers are not in a position of knowing. They do not have a pretest to measure what the student knew on entering the course. They do not have an objectives based test to measure with precision an objective of the course and they do not have

follow-up tests on that same objective for measuring retention overtime.

Another Possibility -

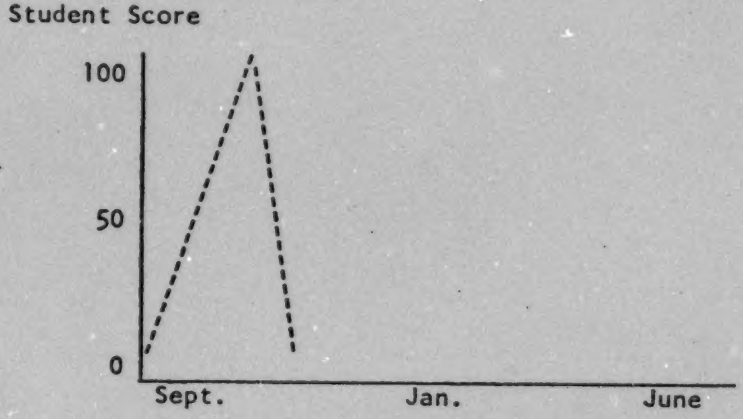


In this "little bit at a time" learning, the student learns each time the teacher teaches. He does not forget and the increments are even. Again, this is probably not a regular pattern. Even so it would require a pretest, test and retention test pattern to know that this is occurring.

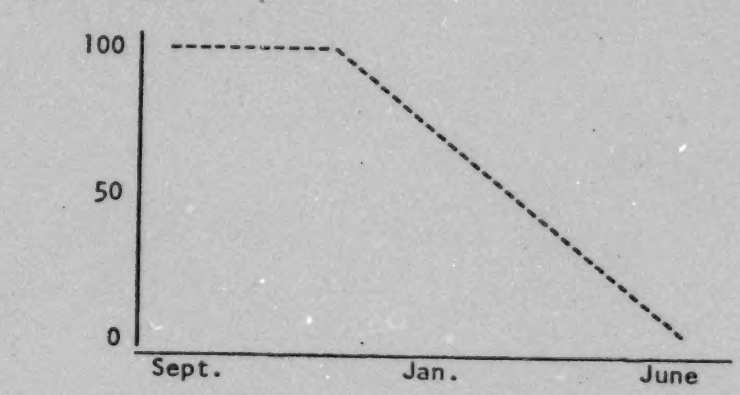


In this pattern the student came into the course knowing this

part. He did not forget it and regular instruction had no effect. With pretest information and objective follow-up tests the teacher would be in a position to go on to teaching something else to a student who exhibited such characteristics.



In this pattern a student enters not knowing the objective. He is taught and learns it very well. However, at the next testing he scores near zero again. This pattern indicates forgetting. This system of testing indicates that re-teaching is now necessary.



In this pattern, one that every teacher has probably felt, the

student enters the class knowing the objective. The teacher teaches for this objective and the student promptly becomes confused. This situation is probably inevitable in every class. It really poses no problem unless the teacher does not gain the information that the student is now confused. This requires the pretest test and re-test pattern.

None of this is new. Experts in evaluation have long preached it as a way of knowing the effects of our instruction. The problem has always been that

a. stating the objective
b. making the tests
c. scoring tests
d. writing reports for the student and others interested in his progress

have been too time consuming and too complex to be done regularly by an individual teacher.

Comprehensive Achievement Monitoring, which was outlined for us by Dr. O'Reilly and Dr. Gorth, was a system for employing the computer to keep track of objectives and student performance, to write reports, to keep cumulative information from test to test for individual objectives or for total test.

In the following pages I will attempt to describe and explain the Comprehensive Achievement Monitoring System that was developed in Brentwood. In our school district we (in the happy American

tradition of creating acronyms for everything) called it B.E.S.T. Brentwood Educational System for Testing.

The components of the system are:

1. Behavioral Objectives
2. Test item bank
3. Test construction program
4. Six test forms for each level for each semester
5. Answer keys
6. Cross reference guides
7. Manuals for students, parents, visitors
8. Forms for entering information into the various data banks:
    a. objective entry form
    b. item entry form
    c. student update - add and drop form
    d. test construction form

Administrators and teachers in our district (section or implementation will explain process) selected and wrote behavioral objectives appropriate for our students for grades 4, 5, and 6. Eight basic strands were developed for the program:

1. Numbers & Numeration
2. Basic Operations with Natural Numbers
3. Rational Numbers
4. Decimals

5. Number Sentences
6. Word Problems
7. Measurement
8. Geometry

For each of these topics discrete objectives were written. (see fig. 1)

In order to keep track of the objectives and to have the computer manipulate them a coding system had to be developed. A simple procedure was developed.

01	00	00	00
Math	Grade	Topic	Specific Objective

so that objective #01 04 02 01 means

a. math objective
b. fourth grade
c. second topic (basic operations with natural numbers)
d. first objective

For this monitoring system a bank with a minimum of four test items is required for each objective. The quality of these test items can be determined at the end of a semester or year through a detailed item analysis supplied by the computer. However, in the first writing of test items the following procedure helps to assure that items will reasonably test the objectives they purport to test.

a. A good objective has implicite a test item included.

Example: OBJECTIVE - The student will demonstrate the

04-02-006-00 Multiplication

X OBJECTIVE: Students will select the natural number which is the correct answer to a given multiplication problem. The multiplication problem may be of two types:
1) the multiplicand is a 3-digit number and the multiplier is a 2-digit number;
2) the multiplier and multiplicand are both 2-digit numbers.

EXAMPLE:
$$\begin{array}{r} 253 \\ \times\ 32 \\ \hline \end{array}$$

(A) 9096 (B) 7090

(C) 8096 (D) 8090

Second semester

04-02-007-00 Division

X OBJECTIVE: Students will select the correct answer to a given division problem of natural numbers. The divisor may have one or two digits, and the dividend will have four or fewer digits.

EXAMPLE: $15\overline{)3926}$

(A) 265 R12 (B) 261 R5

(C) 65 R11 (D) 261 R11

Second semester

RATIONAL NUMBERS

04-03-001-00 Equivalent fractions

X OBJECTIVE: Students will select the proper fraction that is not equivalent. The denominators of all equivalent fractions will be less than or equal to 100.

EXAMPLE: Which fraction is not equivalent to $\frac{1}{2}$?

(A) $\frac{4}{8}$ (B) $\frac{5}{9}$

(C) $\frac{8}{16}$ (D) $\frac{10}{20}$

(fig. 1) - Objective Bank

ability to count to 100.

TEST ITEM - 4, 5, 6, ___

(a) 5

(b) 7

(c) 8

(d) 9

If the test item closely reflects the objective, it is likely a suitable item.

b. Reading analysis is sometimes needed to determine appropriateness of

1. vocabulary in the item
2. sentence length in the item
3. sentence complexity in the item.

c. In the multiple choice format the quality of the distractors is an important part of the quality of the test item. The two most common problems with distractors are

1. The distractor is so close to being the correct answer that it may not discriminate between a simple student error and a lack of understanding.
2. The distractor is so obvious that it could not possibly be considered as a suitable answer by any student.

The multiple choice format was chosen for the testing program because it most easily lends itself to computer-

ized testing and scoring. In a well constructed item in mathematics, the chances of a student's guessing the correct answer is 25%. However, keeping in mind that the student will be tested six times in each semester, we can figure the guessing odds another way. The chances that a student will guess the correct answer on two tests in a row are .0625 which is a very small chance indeed. (see fig. 2)

Naturally it was necessary to develop a coding system to enter test items in the computer bank. Test items were coded as follows:

00	00	00	00	00
Math	Grade	Topic	Objective	Item #

In order to make a monitoring system from a bank of objectives and a bank of test items a test construction program is necessary. The system decided upon for Brentwood has been to first develop the trend testing system to be followed and supported two years later by a mastery testing system.

The monitoring system initially designed to take advantage of the computer's speed and capacity for storing and reporting on large numbers of variables. In addition, the CAM system makes it possible to test students frequently on a large number of objectives while using a limited number of test items. There are a number of reasons that this is desirable. One example is the length of the test. The monitoring system, which uses six tests per semester, will have six different test forms. If four test items are available for each

04-02-006-00 Multiplication

OBJECTIVE: Students will select the natural number which is the correct answer to a given multiplication problem. The multiplication problem may be of two types:
1) the multiplicand is a 3-digit number and the multiplier is a 2-digit number;
2) the multiplier and multiplicand are both 2-digit numbers.

X EXAMPLE:
$$\begin{array}{r} 253 \\ \times\ 32 \\ \hline \end{array}$$

(A) 9096 (B) 7090

(C) 8096 (D) 8090

Second semester

04-02-007-00 Division

OBJECTIVE: Students will select the correct answer to a given division problem of natural numbers. The divisor may have one or two digits, and the dividend will have four or fewer digits.

X EXAMPLE: $15\overline{)3926}$

(A) 265 R12 (B) 261 R5

(C) 65 R11 (D) 261 R11

Second semester

RATIONAL NUMBERS

04-03-001-00 Equivalent fractions

OBJECTIVE: Students will select the proper fraction that is not equivalent. The denominators of all equivalent fractions will be less than or equal to 100.

X EXAMPLE: Which fraction is not equivalent to $\frac{1}{2}$?

(A) $\frac{4}{8}$ (B) $\frac{5}{9}$

(C) $\frac{8}{16}$ (D) $\frac{10}{20}$

(fig. 2) - Item Bank

objective, each test will test 4/6 of the objectives. Stated another way, over a course of six tests an individual student will be tested four times on each objective. The whole class will be tested on all of the objectives. After the second test all students in the class will have been tested at least one time on each objective selected.

The computer program for assigning students to tests works this way.

1. There will be six tests.
2. There will be six forms for each test to be sure that students do not take a form of the test more than one time and to assure that each student will take all the test forms a table is developed. First six groups are created in each classroom. Then they are assigned test forms by the computer in the following manner:

Group 1	-	Tests	2	3	4	5	6	1
Group 2	-	Tests	3	4	5	6	1	2
Group 3	-	Tests	4	5	6	1	2	3
Group 4	-	Tests	5	6	1	2	3	4
Group 5	-	Tests	6	1	2	3	4	5
Group 6	-	Tests	1	2	3	4	5	6

There are many advantages to this kind of sampling. First, it practically eliminates the problem of cheating on tests. Since students cannot be sure that a neighbor has the same test form,

there is little point in cheating. Secondly,the tests can be of reasonable duration. If all students were tested on all objectives in each test the test would,in this case, necessarily be 1/3 longer. The tests which are given twelve times a year, last from 30 to 40 minutes. Economy in time required is important when there is such a test frequency.

The computer will assign student groups to each test form; it will also assign objectives and test items to each of the six test forms. (See Appendix G, N.Y.S.E.D. Cobol format)

The resulting six test forms in multiple choice format, (See Appendix H) are then available for student use: The following kinds of question (see fig. 3). There would be 25 on each test that would be responded to. This is one of the two kinds of testing systems developed within the BEST Program. The definition of objectives by grade or difficulty level, the computerized random assignment of test forms for the purpose of sampling student performance regularly on the total set of objectives; this is the Trend test aspect of the program. A complete set of the Trend tests in the BEST system may be seen in appendix H.

Mastery tests are different in that one objective is tested five or more times on one test to establish a level of mastery such as five out of five, four out of five, etc. The Brentwood set of mastery tests may be seen in appendix D.

17

6 LB. 27 OZ.
-3 LBS.13 OZ.

(A) 3 LB. 14 OZ. (B) 4 LB. 1 OZ. (C) 4 LBS. 10 OZ. (D) 4 LB. 4 OZ.

18

ONE SCHOOL BUS CAN CARRY 47 STUDENTS. HOW MANY STUDENTS CAN 7 SCHOOL BUSES CARRY?

(A) 7 (B) 289 (C) 329 (D) 747

19

IF JOHN BOUGHT 213 JELLY BEANS EACH DAY, HOW MANY JELLY BEANS WOULD HE HAVE IN 67 DAYS?

(A) 4,271 (B) 14,161 (C) 14,271 (D) 4,161

20

WHICH FRACTION IS NOT EQUIVALENT TO $\frac{3}{8}$?

(A) $\frac{6}{16}$ (B) $\frac{21}{56}$ (C) $\frac{12}{32}$ (D) $\frac{6}{18}$

(fig. 3)
Math Monitoring Test
sample page

A class of 30 students would have groups of five students taking each of the six test forms. The student will have a pre-printed answer sheet. (see fig. 4) Across the top is listed the student number (assigned by census department when student enrolls), student name, school number, grade and homeroom number. The teacher is also designated by number, usually the same as the homeroom number.

Spaces are provided for the student to mark the answers he believes to be correct. A regular number pencil is used. Our first attempts required use of a grease pencil. Somehow, we could never have enough of these on hand when they were needed. This problem disappeared when the program was changed to use ordinary pencils.

The bottom half of the page lists the objective numbers for the course that this student is currently enrolled in. The teacher marks or has the students mark the numbers of the objectives that have been taught since the last trend test.

The entire procedure of coding for the computer was handled in the curriculum office. The well defined procedure has evolved the following, presently used forms, which organize information for the key punch operators at the data processing office:

1. Objective Bank Updating Form (see fig. 5)

   The action box offers three possiblities - 0 = delete, 1 = new, meaning to add this objective, and 2 = change,

BRENTWOOD EDUCATIONAL SYSTEM FOR TESTING

THIS SECTION FOR DATA PROCESSING USE ONLY. DO NOT PUT ANY MARKS IN THIS SECTION

STUDENT NO	STUDENT NAME	SCH	GRADE	NORM	TEACHER	SECT	AREA	PERIOD	TEST NO
227131	CLEMENT JOSEPH	8	4	000	406	01	1	2	114202

PART 1 STUDENT ANSWER SECTION. INSTRUCTIONS FOR FILLING OUT THIS SECTION.

1. CHOOSE ONLY ONE BOX FOR EACH QUESTION.
2. USE A NO. 2 PENCIL TO MARK THE BOX OF YOUR CHOICE.
3. SHOULD YOU WISH TO CHANGE YOUR CHOICE, COMPLETELY ERASE THE OLD MARK.

1	8	15	22	29	36	43	50		
2	9	16	23	30	37	44	51		
3	10	17	24	31	38	45	52		
4	11	18	25	32	39	46	53		
5	12	19	26	33	40	47	54		
6	13	20	27	34	41	48	55		
7	14	21	28	35	42	49	56		

PART 2. OBJECTIVE SECTION. INSTRUCTIONS FOR FILLING OUT THIS SECTION.

1. LISTED BELOW ARE THE OBJECTIVES FOR THE CURRENT SEMESTER
2. USING A NO. 2 PENCIL. MARK THE BOX LABELED YES FOR EACH OBJECTIVE TAUGHT SINCE THE PREVIOUS TREND TEST.
3. SHOULD YOU WISH TO CHANGE A MARK, COMPLETELY ERASE THE OLD MARK.

OBJECTIVE NUMBER	TAUGHT YES	TAUGHT NO	OBJECTIVE NUMBER	TAUGHT YES	TAUGHT NO	OBJECTIVE NUMBER	TAUGHT YES	TAUGHT NO	OBJECTIVE NUMBER	TAUGHT YES	TAUGHT NO
14201004			14201006			14201007			14201008		
14202004			14202005			14202006			14202007		
14203001			14203002			14203003			14203004		
14203005			14203006			14203007			14205001		
14205002			14205003			14206001			14206004		
14206005			14206006			14206008			14206009		
14206010			14207003			14207004			14207005		
14207006			14208002			14208003					

(fig. 4) Student Answer Sheet

Objective Bank Updating Form

Code	ACTION 0 = Delete 1 = New 2 = Change	OBJECTIVE NUMBER Area	Level	Topic	Number	SUB TOPICS 1	2	Source	No. of Text Lines Entered
•	1	2	09	06	001			1	03
1	2	3 4	5 6	7 8	9 10	11 12	13 14	15	16 17

INSTRUCTIONS FOR COMPLETION

I. NEW OBJECTIVES

a) Enter a "1" under Action.
b) Enter the objective number.
c) Enter sub topic (s) code if desired.
d) Enter source code of objectives.
e) Enter the No. of text lines used.
f) Under Print Line enter the line number which the corresponding text is to print on.
g) Enter actual text as it is to appear on all print outs.

II. DELETE AN OBJECTIVE

a) Enter "0" under action.
b) Enter the objective number.
NOTE All items pertaining to the objective will also be deleted.

III. CHANGING AN OBJECTIVE

NOTE An objective number may not be changed using the change action, instead one must delete the present objective and create a new objective.
a) Enter a "2" under action.
b) Enter the objective number.
c) If changing or adding a sub topic (s) enter the correct sub topic code (s) in the appropriate numbered area.
d) If changing or adding the source of an objective, enter the correct source code in the source area.
e) A change in the No. of text lines entered or in the actual text of an item requires that the items entire text be renumbered together with its correct No. of lines entered.

Print Line	TEXT
01	GIVEN SELECTIONS CONTAINING SENTENCES IN WHICH IDEAS CAN BE
02	INFERRED FROM WORDS OR WORD GROUPS, THE PUPIL WILL BE ABLE
03	TO MAKE THE DESIRED INFERENCE.

37 (Fig. 5) - Form used for entering, changing or deleting objectives

meaning only the change indicated in the text is to be made. The objective number was previously discussed. In the objective number the area refers to math, reading or other subject. In Brentwood, math is always 1. Level means grade level or difficulty level. Topic refers to one of the eight strands of the program. Number identifies the position of the object in the sequence of objects for this topic. Four boxes for sub-topics have not been used in the elementary program up to this point. The source box provides for a code to identify the source of the object. 1 stands for Brentwood, 2 stands for New York State Education Department, etc. The next two boxes identify the number of lines of text in this objective. The text of the objective is then written in, one box for each letter, space, punctuation, etc. This form has been widely used in our reading program. It does not provide for mathematical symbols and and geometric figures. Until we can code those figures for the computer, they will have to be drawn by hand and stored on paper.

2. Item Bank Updating Form (see fig. 6)

This form follows essentially the same procedure for adding items, deleting items and changing items. Storing objectives and items is half of the storage bank problem. The other half is recording and keeping current

Item Bank Updating Form

Code	Action (0 = Delete, 1 = Add, 2 = Change)	Objective Number: Area	Level	Topic	Number	Item Number	Answer	Source	No. of Text Lines Entered
1	1	2	0	9	4	0	2	1	0 6
2	3	4	5	6	7	8	9	10	11 12	13	14	15	16 17

INSTRUCTIONS FOR COMPLETION

I. NEW ITEMS

a) Enter a "1" under Action.
b) Enter the objective number.
c) Enter the item number.
d) Enter the answer.
e) Enter the source code of the item.
f) Enter the number of text lines used.
g) Under Print Line enter the line number which the corresponding text is to print on.
h) Enter actual text as it is to appear on all print outs.

II. DELETE AN ITEM

a) Enter "0" under action.
b) Enter the objective number.
c) Enter the item number.
NOTE If an objective is deleted, data processing will automatically delete all items for that objective.

III. CHANGING AN ITEM

NOTE The objective and item numbers may not be changed using the change action, instead one must delete the present item and create a new item.
a) Enter a "2" under Action.
b) Enter the objective number.
c) Enter the item number.
d) If changing an items answer, enter the correct answer in the answer area.
e) If changing or adding the source of an objective, enter the correct source code in the source area
f) A change in the No. of text lines entered or in the actual text of an item requires that the items entire text be resubmitted together with its correct No. of lines entered.

Print Line	TEXT
01	CHOOSE THE ANSWER THAT GOES BEST WITH THE SENTENCE.
03	THE BABY HAD TROUBLE STAYING ON HIS FEET.
05	A) HE WAS STEADY.
06	B) HE WAS UNSTEADY.
07	C) HE WAS FEARFUL.
08	D) HE WAS UNCLEAR.

(Fig. 6) - Form used for entering, changing or deleting test items

the millions of bits of information about students.

3. Update Student Bank Form (see fig 7)

This form provides the means to enter, delete and change data about students in the programs. The first line of information identifies the student by name, number, school and grade. It also provides space to indicate whether this is an addition, deletion or change. Four identical blocks are available below because students in Brentwood may potentially be entered in four areas; for example: 1 - Math, 2 - Reading, 3 - Spelling and 4 - Language Arts. Each of these areas would need information to indicate

a. area (which subject)
b. teacher
c. course
d. section
e. group

Each test period, the student has an opportunity to move from one ability level to another. The teacher may change the level at which the student is being tested by simply indicating the new student level for the test period coming.

4. Teacher Names Form (see fig. 8)

This form is for coding teacher names and numbers for each school.

Update Student Bank Form

Action
0 = Delete
1 = New
2 = Change

Cd	Action	Student No	LAST NAME	FIRST NAME	School	Grade
K	1	665355	SHIELDS	KAREN	08	04
1	2	4 5 6 7 8 9	10 11 12 13 14 15 16 17 18 19 20 21	22 23 24 25 26 27 28 29 30 31	32 33	34 35

Card 1
3

AREA INFORMATION

Area	Teacher	Course	Sect	Grp	LEVELS Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
2	210	000	00	0	08					
36	37 38 39	40 41 42	43 44	45	46 47 48 49 50 51 52 53 54 55 56 57					

AREA INFORMATION

Area	Teacher	Course	Sect	Grp	LEVELS Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
58	59 60 61	62 63 64	65 66	67	68 69 70 71 72 73 74 75 76 77 78 79					

Card 2
3

AREA INFORMATION

Area	Teacher	Course	Sect	Grp	LEVELS Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
36	37 38 39	40 41 42	43 44	45	46 47 48 49 50 51 52 53 54 55 56 57					

AREA INFORMATION

Area	Teacher	Course	Sect	Grp	LEVELS Test 1	Test 2	Test 3	Test 4	Test 5	Test 6
58	59 60 61	62 63 64	65 66	67	68 69 70 71 72 73 74 75 76 77 78 79					

(fig. 7) - Form used for entering, changing or altering information about a student in the program.

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-32)

TEACHER NAMES

CARD CODE M3

SCHOOL NO. ☐☐

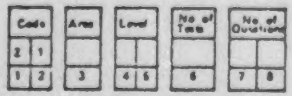
	Teacher Number	Teacher Name
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
21.		
22.		
23.		
24.		
25.		
26.		
27.		
28.		
29.		
30.		
31.		
32.		
33.		
34.		
35.		

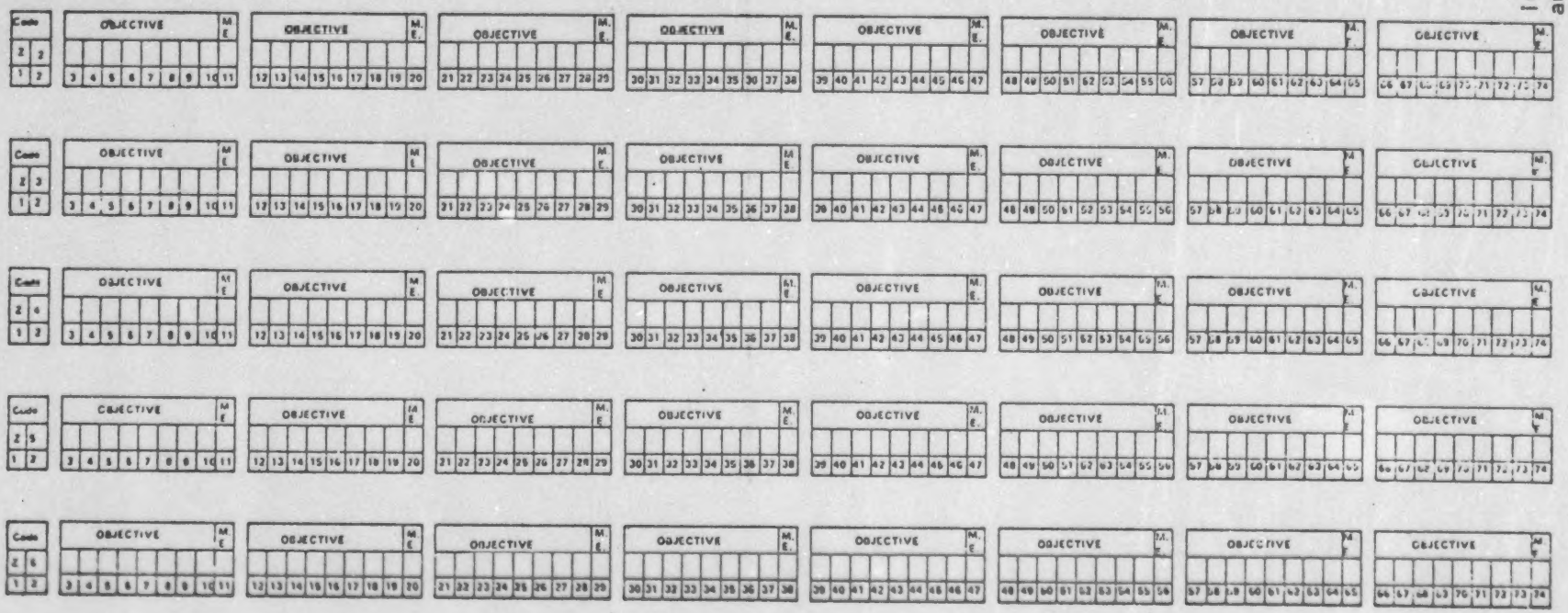
(fig. 8) - Form for generating computer listing of teachers in program

5. Test Construction (see fig. 9)

This indicates another immediate product from operation of the computer program. Student information produces first the answer sheet. Objective, item and test form information produces a testing of itmes in sequence as they will appear on each test form. Once this form has been produced, it is a simple task to retrieve the item cards and set them up in test form. These are then photographed and the tests are produced.

Test Construction





(fig. 9) - Form for indicating test items used and position occupied on each test

III. The Reports. A test schedule is published prior to the beginning of the year. On the day of the test, the team leader and an aide and teacher distribute answer sheets being very careful that each student has the precise test called for by the students computer pre-printed answer sheet. Students take the test. The tests are collected and sent to the district curriculum office where they are spot checked. The entire district's tests are then sent to the data processing center where they are read by the op-scan machine which produces key punched cards which are then processed by the computer. By nine o'clock the following morning the reports are picked up and distributed to the schools by the curriculum office.

The following reports are produced by the computer in the Brentwood Educational System for Testing:

1. Trend Test Student Report (see fig. 10)

   This report is designed to be taken home by the student. The information is rather straightforward. All the necessary information concerning the student name, number and section, his teacher's number and school number at the left from top to bottom are listed, and the topics and objective numbers that were tested. The students had previously taken home the Manual for Students and Parents (see appendix B). Using the manual, the students and parents can find the specific objective that was tested. The manual always gives a test item sample with each ob-

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TREND TEST: STUDENT REPORT

STUDENT NAME : THANHAUSER KERRI ANN STUDENT NO: 713596
TEACHER NUMBER: 504 SUBJECT: MATH
COURSE NUMBER : 000 DATE : 04/15/75
SECTION NUMBER: 01 SCHOOL : 08

TOPIC NAME	OBJECTIVES	TEST PERIOD NUMBER 1	2	3	4	5	6
NUMBERS AND NUMERATION	15201004						
NUMBERS AND NUMERATION	15201005	C		CT			
NUMBERS AND NUMERATION	15201006	C		CT			
NUMBERS AND NUMERATION	15201007	C	CT				
NUMBERS AND NUMERATION	15201008	W	CT	CT			
NUMBERS AND NUMERATION	15201009	C	CT	CT			
NATURAL NUMBER OPERATIONS	15202003	C	CT				
NATURAL NUMBER OPERATIONS	15202004	C	CT				
RATIONAL NUMBERS	15203001	W	CT				
RATIONAL NUMBERS	15203002	W					
RATIONAL NUMBERS	15203003		CT	CT			
RATIONAL NUMBERS	15203004		CT	CT			
RATIONAL NUMBERS	15203005	W	W	C			
RATIONAL NUMBERS	15203006	W		C			
RATIONAL NUMBERS	15203007	C	CT	CT			
RATIONAL NUMBERS	15203008	W		CT			
RATIONAL NUMBERS	15203009	W	CT	CT			
RATIONAL NUMBERS	15203010	W	W	W			
RATIONAL NUMBERS	15203011	C	W				
DECIMALS	15204001	W	N	C			
DECIMALS	15204002		C	W			
DECIMALS	15204003		C	C			
DECIMALS	15204004	C	C				
DECIMALS	15204005	W		W			
DECIMALS	15204008						
NUMBER SENTENCES	15205005		C	C			
NUMBER SENTENCES	15205006	W					
NUMBER SENTENCES	15205007	W	W				
NUMBER SENTENCES	15205008		C	C			
WORD PROBLEMS	15206001			C			
WORD PROBLEMS	15206004		C				
WORD PROBLEMS	15206005	W		C			
WORD PROBLEMS	15206006			C			
WORD PROBLEMS	15206007	C		C			
WORD PROBLEMS	15206009	C	W				
MEASUREMENT	15207002		C	C			
GEOMETRY	15208002		W	W			
GEOMETRY	15208003	W	C				
GEOMETRY	15208008			W			

SCORE KEY : C=CORRECT, W=WRONG, N=NO RESPONSE, T=POSTINSTRUCTIONAL

	TEST PERIOD NUMBER 1	2	3	4	5	6
PERCENT CORRECT OF TOTAL	44	72	80			
PERCENT CORRECT OF POSTINSTRUCTIONAL		100	100			

Great!!
Absolutely
+ now
Mrs. Pearson

PARENTS COMMENTS:

(Fig. 10) - Monitoring system report for the students

jective statement. In matching the student report with the manual the student, teacher and parent cover objective by objective by objective the student's performance on the test of the previous day. The code at the bottom of the page indicates that a

C means correct

W means wrong

N means the student did not answer the question

T means that this objective has been taught

Implications for decision making will be discussed later. The bottom ofthe student report also gives a percent score on all the items and another percent score for those test items on which the teachers have indicated that teaching has taken place.

2. Content Summary Report (see fig. 11)

This report is designed to give the teacher information about group performance on the objectives that were tested down the left column the objectives are listed. Again, the teacher has a manual which is a key for providing statements of the objectives and sample test items. The figure under column A tells the number of responses that were made for that objective. Column B gives the percent correct of those responses. Column C lists the number of responses on objectives that the teacher had indicated as

TREND TEST: CONTENT SUMMARY REPORT

DATE:

TEACHER NO: 422
STUDENT GROUP = LEVEL

SUBJECT: MATH
SCHOOL NO: 03

TEST PERIOD NUMBER:

OBJECTIVES	1 A	1 B	1 C	1 D	2 A	2 B	2 C	2 D	3 A	3 B	3 C	3 D	4 A	4 B	4 C	4 D	5 A	5 B	5 C	5 D	6 A	6 B	6 C	6 D
14201004	22	68			25	40			26	46														
14201006	17	41			19	26			20	20														
14201007	20	20			18	44			23	30														
14201008	17	71	17	71	21	57	18	61	21	52	20	50												
14202004	19	32	19	32	17	65	16	63	21	38	18	39												
14202005	17	71	17	71	19	84	18	83	20	80	19	79												
14202006	17	29	17	29	21	67	18	61	21	67	20	70												
14202007	24	33			24	25			28	43	6	67												
14203001	19	32	19	32	19	37	19	37	20	40	17	41												
14203002	18	61	18	61	19	63	18	61	21	81	19	79												
14203003	20	35	4	100	19	58	3	100	21	57	6	67												
14203004	19	95	18	94	21	90	18	89	21	95	17	94												
14203005	19	100	19	100	17	88	16	88	21	100	18	100												
14203006	19	63	6	83	20	45	4	50	23	48	4	50												
14203007	18	33	18	33	20	55	17	59	22	45	20	45												
14205001	18	72	18	72	20	85	17	82	22	77	20	75												
14205002	19	68	19	68	19	84	18	83	20	85	16	81												
14205003	19	95	19	95	19	100	16	100	22	91	19	95												
14206001	20	55	6	67	20	50	3	33	22	45	6	67												
14206004	19	74	19	74	18	89	17	88	22	95	19	95												
14206005	18	50	12	33	20	70	13	69	22	77	14	71												
14206006	18	44	18	44	21	48	19	53	20	65	18	61												
14206008	19	95	16	94	17	100	11	100	21	100	14	100												
14206009	19	68	19	68	21	62	19	63	21	57	18	56												
14206010	18	39	14	29	19	47	13	38	21	43	15	40												
14207003	19	47	1	0	21	57	1	100	21	48														
14207004	20	55	1	0	18	67	1	0	23	48	18	50												
14207005	18	56	1	0	20	40			22	55	15	40												
14207006	20	10			19	26			21	29														
14208002	20	40			19	58			21	71														
14208003	19	79			19	79			22	86	22	86												

A = TOTAL RESPONSES
B = PERCENT CORRECT OF TOTAL RESPONSES (A)
C = TOTAL OF POSTINSTRUCTIONAL RESPONSES
D = PERCENT CORRECT OF POSTINSTRUCTIONAL RESPONSES (C)

(fig. 11) - Monitoring system report to teachers listing class performance by objective

taught and Column D indicates the percent correct on the objectives that had been taught. The information is cumulative for each test period for the entire semester.

3. Teacher Summary Report (see fig. 12)

This report lists all the students in a teacher's class with a score on the total test.

4. Content Summary Report for School Principal (see fig. 13)

This report is organized in the same pattern as the teacher's content summary report. However, the principal's report tells how all the students at a given level or grade have performed on each objective for the level or grade. Besides giving the principal a feeling of achievement or lack of achievement at each level, this report provides him with some specific information such as:

a. How many students have been taught for a particular objective at each level.

b. How well groups of students are performing on those objectives which have been taught.

In addition, this kind of report can be used by teachers at a grade level for re-grouping students for review or introduction of materials according to similar deficiencies or accomplishments. Altogether the information on this report helps provide a basis for discussion about student growth in an academic subject.

TREND TEST: TEACHER SUMMARY REPORT

TEACHER NO: 626
SECTION NO: 01
LEVEL : 06

SUBJECT: MATH
SCHOOL NO: 04

STUDENT NAMES		TEST PERIOD NUMBER 1				2				3				4				5				6			
		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
CHIAVOLA	STEVEN	25	60	11	82	25	76	12	83	25	64	8	88	25	64	14	79	25	60	21	62				
CORDOVA	PETER	25	20	2	0	25	28	2	0	25	12	1	0	25	20	1	0	25	12	3	0				
CUNHA	ARMANDO					25	24							25	28			25	28	4	75				
DEL VECCHIO	ROBERT	25	20	5	40	25	32	4	25	25	32	2	50	25	24	2	50	25	32	5	60				
FERNANDES	SEVERO	25	44	9	67	25	68	10	80	25	68	12	92	25	72	13	85	25	76	13	77				
FUSCO	NANCY	25	56	8	88	25	68	8	100	25	72	8	88	25	80	16	81	25	64	21	71				
GELOSI	JOSEPH	25	84	11	82	25	92	12	100	25	92	8	88	25	84	14	93	25	84	21	86				
KALOMERES	GEORGE	25	28	5	40	25	16	4	0	25	24	2	50	25	40	2	50	25	20	5	20				
MALDONADO	ELIZABETH	25	20	1	0	25	32	1	0	25	24			25	20	1	100	25	20	3	0				
MARROW	BRENDA	25	20	1	0	25	20			25	36	1	100	25	16	1	0	25	20	3	0				
MARTELLO	JOHN	25	20	4	50					25	28	5	20	25	40	4	75	25	32	5	80				
MERCADO	RICHARD					25	24			25	36			25	16			25	12	2	0				
NOGUERA	RICARDO	25	28	5	40	25	20	2	50					25	20	4	50	25	40	7	86				
OLIVENCIA	RAYMOND	25	24			25	16	1	0	25	32	1	0	25	40	1	100	25	36	4	50				
PATERNO	LAURA	25	20	2	0	25	20	2	0	25	16	1	0	25	36	1	0	25	16	3	67				
PROUT	MARK	25	36	1	0	25	24	1	0	25	16	1	100	25	8	1	0	25	24	4	0				
REUTER	MICHAEL	25	40	1	100	25	40			25	36	1	0	25	24	3	33	25	28	4	0				
ROBERTS	ANTONIO	25	28	4	25	25	24	4	50	25	32	5	60	25	48	8	63	25	28	6	33				
ROSA	MILDRED	25	72	12	92	25	64	8	100	25	76	8	100	25	64	15	80	25	88	23	91				
SMITH	JAMES	25	28	3	67	25	16	5	20	25	20	7	29	25	40	8	25	25	40	7	71				
SMITH	INEZ	25	32	1	0	25	20	1	0	25	28	1	0					25	28	3	0				
TICKLE	COLLEEN	25	24	1	0	25	36	1	0	25	20	1	0	25	36	1	100	25	36	4	75				
WAGNER	ROBERT JR	25	40	8	50	25	60	9	78	25	60	9	78	25	76	16	94	25	64	22	64				
WALSH	TERENCE	25	20	1	0	25	32	1	100	25	44	1	100	25	48	5	80								
YOUNG	DIANE	25	56	8	75	25	48	8	75	25	52	10	90	25	68	15	73	25	60	20	65				

A = TOTAL RESPONSES
B = PERCENT CORRECT OF TOTAL RESPONSES (A)
C = TOTAL OF POSTINSTRUCTIONAL RESPONSES
D = PERCENT CORRECT OF POSTINSTRUCTIONAL RESPONSES (C)

(fig. 12) - Monitoring system report to teacher listing individual performance by total test

TREND TEST: CONTENT SUMMARY REPORT FOR SCHOOL PRINCIPAL DATE: 1

SCHOOL NUMBER : 9 SUBJECT: MATH

STUDENT GROUP = LEVEL 42

TEST PERIOD NUMBER:

	1				2				3				4				5				6			
OBJECTIVES	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
14201004	135	54	42	57	142	48	70	56	146	62	97	65												
14201006	101	17	34	24	115	23	53	36	119	39	97	43												
14201007	121	53	83	58	114	55	70	71	116	48	93	52												
14201008	108	56	53	64	119	59	71	56	120	73	101	73												
14202004	112	48	60	48	114	54	50	52	111	59	73	64												
14202005	101	73	84	79	115	77	97	78	119	72	97	74												
14202006	108	66	51	76	119	66	82	72	120	67	83	70												
14202007	146	31	20	30	152	47	100	51	150	53	123	52												
14203001	113	34	54	39	125	40	59	46	108	45	55	51												
14203002	110	50	56	66	129	47	76	55	119	66	86	71												
14203003	122	20	25	52	114	25	21	48	101	37	55	49												
14203004	120	68	64	94	129	58	61	70	109	87	90	96												
14203005	112	82	35	94	114	64	32	81	111	88	92	93												
14203006	119	30	1	0	129	32	1	0	124	35	21	24												
14203007	110	45	34	53	115	45	37	54	124	60	61	64												
14205001	110	72	50	66	115	72	57	74	124	69	73	70												
14205002	113	63	37	57	125	79	39	69	108	83	74	84												
14205003	119	62	20	70	118	54	16	63	112	79	39	82												
14206001	122	61	52	58	125	64	58	59	113	64	55	60												
14206004	112	75	57	67	125	78	73	79	123	76	76	78												
14206005	110	71	52	67	115	75	54	83	124	79	81	78												
14206006	111	41	17	59	115	42	16	69	109	44	37	41												
14206008	112	86	39	90	114	88	49	88	111	92	56	84												
14206009	120	53	22	73	129	60	61	62	109	60	90	60												
14206010	110	44			129	50	45	49	119	55	82	55												
14207003	120	53			129	62	22	68	109	61	57	58												
14207004	121	56			114	48	16	69	116	56	58	69												
14207005	110	51			115	65			124	69	31	71												
14207006	122	24			114	56	35	69	101	52	49	57												
14208002	122	52			114	61			101	57														
14208003	119	91			118	85			112	87	44	89												

A = TOTAL RESPONSES
B = PERCENT CORRECT OF TOTAL RESPONSES (A)
C = TOTAL OF POSTINSTRUCTIONAL RESPONSES
D = PERCENT CORRECT OF POSTINSTRUCTIONAL RESPONSES (C)

(fig. 13)

Monitoring system report for principal listing student performance of total level on each objective

5. Content Summary Report for Administration. (see fig. 14)
This report is similar to the principal's report. However, it provides information districtwide about student performance at grade levels on different levels. This information is invaluable in considering questions of
a. effectiveness of specific materials
b. effectiveness of programs, methods
c. appropriateness of particular objectives or test items.
d. sequence of materials and problems.
Curriculum planners too often must make judgements about programs without information systems. Without such a system there is considerably less rational basis.

6. Student Performance Analysis by Class. (see fig. 15)
This report which is provided to each teacher after each test, twelve times a year is very important to most of our teachers. It lists all the students in a teacher's class. Across the top of the page each objective for the level is printed. To the right of each student's name there appears the designation
C = Correct for that objective
W = Wrong for that objective
N = No response for that objective
CT, WT, means correct and taught and incorrect and taught
At a glance a teacher sees individual performance objective

TREND TEST: CONTENT SUMMARY REPORT FOR ADMINISTRATION

DATE:

SUBJECT: MATH

STUDENT GROUP ACROSS SCHOOLS = LEVEL 42

TEST PERIOD NUMBER:

	1				2				3				4				5				6			
OBJECTIVES	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
14201004	1227	40	163	47	1295	41	260	47	1275	49	402	54												
14201006	991	25	123	34	1040	30	201	41	1020	29	259	46												
14201007	983	30	187	45	1040	30	207	51	1020	34	305	51												
14201008	983	52	270	61	1015	54	358	59	1028	57	478	66												
14202004	993	37	229	46	1028	42	284	51	1043	45	425	55												
14202005	991	62	488	67	1039	64	706	67	1020	62	719	67												
14202006	983	49	303	63	1014	55	489	72	1028	59	624	69												
14202007	1226	29	80	46	1297	31	191	44	1257	37	299	51												
14203001	978	33	238	41	1027	35	277	48	1023	36	363	47												
14203002	992	41	238	60	1005	45	292	61	1034	49	372	66												
14203003	971	22	97	43	1025	25	93	47	1040	26	191	43												
14203004	970	51	247	85	1002	55	286	76	1025	63	448	91												
14203005	993	60	208	86	1028	60	230	83	1043	70	400	88												
14203006	982	34	39	46	1016	32	69	39	1010	32	142	35												
14203007	981	36	196	48	1050	39	190	60	996	46	293	60												
14205001	981	61	280	71	1051	62	413	64	997	65	443	71												
14205002	978	63	283	69	1027	68	374	72	1023	70	482	74												
14205003	985	51	128	81	1003	51	121	70	1051	63	240	85												
14206001	968	59	199	57	1038	60	332	59	999	62	331	64												
14206004	990	70	287	74	1042	68	444	74	1003	71	473	78												
14206005	981	61	153	68	1050	63	299	71	996	67	361	74												
14206006	969	35	74	50	1036	37	132	50	1017	38	187	51												
14206008	993	82	133	89	1028	81	216	84	1043	85	280	86												
14206009	970	50	147	73	1002	55	275	67	1029	57	401	64												
14206010	992	45	57	46	1005	45	117	40	1034	49	235	54												
14207003	970	52	19	58	1002	53	53	47	1029	52	124	56												
14207004	983	45	19	53	1040	45	53	53	1020	52	122	64												
14207005	981	49	16	50	1051	51	41	34	997	58	98	65												
14207006	971	31	17	47	1025	33	95	57	1040	33	108	51												
14208002	971	51	17	76	1025	54	12	67	1040	58	64	75												
14208003	985	81	39	82	1003	79	106	77	1051	84	280	86												

A = TOTAL RESPONSES
B = PERCENT CORRECT OF TOTAL RESPONSES (A)
C = TOTAL OF POSTINSTRUCTIONAL RESPONSES
D = PERCENT CORRECT OF POSTINSTRUCTIONAL RESPONSES (C)

(fig. 14)

Monitoring system report for Central Administration listing student performance on each objective for all students in school district at each level

STUDENT PERFORMANCE ANALYSIS BY CLASS

TEACHER NO: 027
COURSE NO : 000
SECTION NO: 01

SUBJECT : MATH
SCHOOL NO: 12
TEST NO : 2

| STUDENT-NAME | OBJECTIVES 1 1 1

by objective and the potential for grouping according to similarities and differences in performance for the various objectives. Deborah, Richard, Ray and Karolyn would seem to be a natural study group for the review of objective 15101003. Each of these students scored a wrong answer though this objective had been taught. Many other such "natural" groups and combinations are readily apparent.

This report is a good example of teacher contribution to the improvement of a program. All this information was available before this report was developed. However, teachers repeatedly requested this format because of the visual advantage it provided. They insisted that looking at class performance "at a glance" would make all the information more usable. When the data processing center finally succeeded in producing the report there was a quick acceptance of the report and use of the information.

Also after each test, each school is provided with a

7. Student Bank Update. (see fig. 16)

This is a listing of students in the program after the changes have been made for this period. Team leaders (explained in section on implementation) review the list to make sure all students are correctly entered.

Similar print-outs are available on request from the bank of objectives and test items.

01/23/75

STUDENT I.D.	LAST NAME	1ST NAME	SCHL	GRD	AREA	TCHR	CRS	SECT	GRP	*****LEVELS******	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6
067449	BOYCE	MAUREEN	12	05	1	027	000	01	0	51 51 51 51 51 51	115106	115101	115102	115103	115104	000000
					2	027	000	01	0	11 11 11 11 11 11	121104	121101	121102	000000	000000	000000
067464	BOYCE	PATRICK	12	04	1	417	000	01	0	41 41 41 41 41 41	114104	114105	114106	114101	114102	000000
067715	BOYD	KATHI ANN	12	06	1	031	000	01	0	61 61 61 61 61 61	116101	116102	116103	116104	116105	000000
					2	031	000	01	0	11 11 11 11 11 11	121101	121102	121103	000000	000000	000000
067717	BOYD	KEVIN	12	04	1	024	000	01	0	41 41 41 41 41 41	114105	114106	114101	114102	114103	000000
					2	024	000	01	0	09 09 09 09 09 09	120901	120902	120903	000000	000000	000000
067736	BOYDSTON	GUY	21	07	2	508	037	01	0	10 10 10 10 10 10	121004	121001	121002	000000	000000	000000
067740	BOYD	STEPHEN	08	04	1	406	000	01	0	41 41 41 41 41 41	114106	114101	114102	114103	114104	000000
					2	406	000	01	0	09 09 09 09 09 09	120902	120903	120904	000000	000000	000000
068175	BOYLE	JOHN	14	05	1	524	000	01	0	51 51 51 51 51 51	115101	115102	115103	115104	115105	000000
068325	BOYLE	RICHARD	02	06	1	629	000	01	0	61 61 61 61 61 61	116102	116103	116104	116105	116106	000000
068892	BRACERO	WANDA	08	06	1	601	000	01	0	61 61 61 61 61 61	116103	116104	116105	116106	116101	000000
					2	601	000	01	0	11 11 11 11 11 11	121102	121103	121104	000000	000000	000000
068895	BRACERO	ISAAC	14	05	1	524	000	01	0	00 00 00 00 00 51	000000	000000	000000	000000	000000	000000
069795	BRADY	JOHN	13	05	1	526	000	01	0	51 51 51 51 51 51	115103	115104	115105	115106	115101	000000
069876	BRADY	WILLIAM	13	05	1	529	000	01	0	51 51 51 51 51 51	115104	115105	115106	115101	115102	000000
069877	BRADY	ALANE	13	04	1	423	000	01	0	41 41 41 41 41 41	114101	114102	114103	114104	114105	000000
069927	BRACA	LUCINDA	02	04	1	418	000	01	0	41 41 41 41 41 41	114102	114103	114104	114105	114106	000000
070714	BRANDON	ROGER	08	05	1	503	000	01	0	51 51 51 51 51 51	115105	115106	115101	115102	115103	000000
					2	503	000	01	0	11 11 11 11 11 11	121103	121104	121101	000000	000000	000000
070780	BRANDON	JAMES	09	06	1	620	000	01	0	61 61 61 61 61 61	116104	116105	116106	116101	116102	000000
					2	620	000	01	0	11 11 11 11 11 11	121104	121101	121102	000000	000000	000000
070785	BRANDON	EDWARD	07	06	1	639	000	01	0	61 61 61 61 61 61	116105	116106	116101	116102	116103	000000
071535	BRASCH	DEBORAH	03	04	1	421	000	01	0	41 41 41 41 41 41	114103	114104	114105	114106	114101	000000
071615	BRAUN	D ARLENE	09	05	1	518	000	01	0	51 51 51 51 51 51	115106	115101	115102	115103	115104	202020
					2	517	000	01	0	00 00 08 08 08 08	000000	000000	120801	000000	000000	000000
071620	BRAUN	WILLIAM	08	05	1	506	000	01	0	00 00 00 51 51 51	000000	000000	000000	115101	115102	000000
					2	506	000	01	0	00 00 08 09 09 09	000000	000000	120801	000000	000000	000000
071791	BRAVERMAN	STEVEN	21	07	2	511	017	04	0	08 08 08 08 08 08	120803	120804	120801	000000	000000	000000
071792	BRAVERMAN	LESLIE	02	06	1	628	000	01	0	61 61 61 61 61 61	116106	116101	116102	116103	116104	000000
0723**	BREDENZER	ANGELA	10	05	1	240	000	01	0	61 51 51 51 51 51	115101	115102	115103	115104	115105	000000
					2	024	000	01	0	11 11 11 11 11 11	121101	121102	121103	000000	00	0 000000
072299	BRENNAN	MARIE ANN	03	06	1	638	000	01	0	61 61 61 61 61 61	116101	116102	116103	116104	116105	000000

(Fig. 16)

Computer print-out of current student bank

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8. Item Analysis. (see fig. 17)

At the end of each semester, the computer program automatically supplies to the central office an Item Analysis. This report lists all the test item numbers down the left column. Across the top are listed the choices that were available to the students. No response - meaning the student chose not to answer question. A,B,C,D,E choices both pre-instructional and post-instructional. Next to each test item number there is indicated the number of times a student made one of the twelve possible choices.

This report is extremely important in validating the test items, and improving the quality of distractors. In the middle of the page, test item 2080500102, twelve students chose answer A pre-instructionally and 11 students chose answer D pre-instructionally. This is usually a good indication that there is a problem with the distractor- or the right answer. It is a good signal that this item requires re-writing. Similar patterns can reveal problems with test items. Constant refinement of the test items will result, eventually, in a set of test items which are tailor-made and standardized for the local district.

10/24/72

ITEM ANALYSIS FOR READING AS OF 24/10/73

ITEM	NO RES		A		B		C		D		E	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
080300101	4	0	0	0	6	0	18	1	4	0	0	0
080300102	0	0	2	0	1	0	20	0	9	0	0	0
080300103	1	0	5	0	18	0	7	0	1	0	0	0
080400101	0	0	7	0	11	0	4	0	9	0	1	0
080400102	0	0	2	0	7	0	22	0	1	0	0	0
080400103	4	0	15	0	2	0	9	0	3	0	0	0
080400104	1	0	3	0	6	0	4	0	18	0	0	0
080500101	4	0	5	0	9	0	6	0	8	0	1	0
080500102	0	0	12	0	5	0	4	0	11	0	0	0
080500103	1	0	5	0	9	0	6	0	11	0	0	0
080500104	2	0	4	0	5	0	11	0	9	0	1	0
080600101	1	0	7	0	20	0	4	0	0	0	0	0
080600102	1	0	6	0	7	0	14	0	4	0	0	0
080600103	0	0	3	0	3	0	24	0	2	0	0	0
080700101	0	0	8	0	19	0	4	0	1	0	0	0
080700102	1	0	1	0	8	0	20	0	2	0	0	0
080700103	3	0	3	0	16	1	4	0	4	0	0	0
080800101	0	0	1	0	23	0	3	0	4	0	1	0
080800102	4	0	3	0	7	0	14	0	4	0	1	0
080800103	1	0	3	0	16	0	3	0	9	0	0	0
080900101	0	0	20	0	2	0	7	0	1	0	2	0
080900102	0	0	2	0	3	0	22	0	6	0	0	0
080900103	1	0	8	0	2	0	22	0	4	0	1	0

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(fig. 17) Item Analysis - Reading

Computer Procedure

1. Brentwood has an NCR Century 200. The computer has 32K memory, three 657 high stack disc drives. Companion equipment includes a high speed printer, card reader and Op-Scan 100 mark reader.
2. All banks of information are originated in the curriculum office which optionally submits test items coded on the data processing forms.
3. All forms are keypunched and card listings are sent back to the curriculum office for refinement or confirmation. Any corrections are rekeypunched and a new card listing is generated. This process continues until the card listing is confirmed correct.
4. Objectives (and any items) are then stored in computer accessible banks. The LIST routine generates a district copy of the bank. As curriculums are refined, objectives can be added, deleted or changed in the computer banks by using the ADD, DELETE or CHANGE function respectively. The curriculum office submits the appropriate function forms, and the process cycles as in step 3 until accuracy confirmation is received.
5. Curriculum Office submits Continuous Trend Test construction forms. Process cycles as in step 3 until accuracy confirmation is received.

6. The computer generates Continuous Trend Tests for the semester. These are sent to the district for distribution.
7. Answer keys for the semester are then put up in the computer banks. They are either automatically generated from optional master answer key files, or else the curriculum office must submit Answer Key Forms. In the second case, the process cycles as in step 3 until accuracy confirmation is received. In either case, answer keys are established and a listing is automatically generated for the district's use.
8. A student data base is established on the computer either from an existing base or from input forms. If the base is established from input forms, the process cycles as in step 3. In either case, when the student data base is established the LIST program will generate a district copy.
9. After the student data base is established, the computer generates a semester's set of Test Schedules for each teacher. These are sent to the district for distribution and verification.
10. When Test Schedules have been verified, each teacher receives a semester's set of preprinted student response sheets.
11. Teachers submit any student file function requests a week

before each test.

12. Forms are keypunched and a card listing is made for verification. Any corrections are rekeypunched and a new listing is sent. This process continues until the listing is confirmed correct.
13. Student file maintenance is then processed. The LIST program generates a listing of the refined student date base. This is sent back for distribution.
14. Teachers administer tests.
15. Marksense forms are converted to Op-Scan cards. A sample of 5 out of each 100 cards will be checked to guard against hardware failures on the Op-Scan machine.
16. Tests are processed and student/teacher/content reports are generated for distribution (15 hour turn-a-round time.)

During the summer of 1972 Public Systems Research provided consultation services for programming the Brentwood computer. The program was in Fortran IV and adequately served 2000 students in 4th, 5th and 6th grade mathematics. However, the curriculum office, reading consultants and teachers had already selected objectives and test items to begin Reading Comprehensive Achievement Monitoring.

Difficulties with Fortran IV in the NCR Century 200 precluded any expansion. In the first half of 1973 the Coordinator of Data Processing, Mr. Joseph Rotolo, undertook to reprogram CAM in COBOL. The results surpassed expectations in the following way:

a. turn-around time reduced

b. capability expanded to handle up to four programs for 22000 students

c. increased accuracy

We now process tests at 9¢ (vs 25¢ at Board of Cooperative Educational Services) per student. This is basically an expenditure for paper since all equipment and all salaries were being paid for business and clerical functions. The fact that we now process more than 5000 answer sheets every test period without adding to costs indicates that personnel and equipment were previously under utilized.

IV. Support Materials Developed for the Monitoring Program.

The most obvious need for support materials was for a publication that would open the instructional program for everyone in the school district. A committee of administrators and teachers was formed early in the program to produce such a booklet. The B.E.S.T. Manual for Students and Parents (see appendix B) was the outcome. The booklet attempted the following:

1. To explain the instructional program before the student receives an evaluation.
2. To explain that the student will be tested regularly and that reports will be sent home.
3. To list the minimal set of objectives in mathematics for each level.
4. To supply sample test items
   a. to give an indication on how the students knowledge and skill would be tested
   b. to help make the objective clear by providing an example.

This publication was distributed to students and parents at the beginning of the school year. It was generally well accepted except for a few parents who thought that the instructional program was the school's business and should remain that way. Many parents did not react. Those who did usually had praise for the booklet and the communication about the instructional program.

For further support of the monitoring program, the BEST Committee decided that it was necessary to examine the materials available to Brentwood teachers and to cross-reference the math objectives to those materials. (see appendix E) A Cross Reference Guide was developed for each grade 4, 5 and 6.

The adopted math books were the Houghton Mifflin Series. We had on hand some new texts, some old texts (which were left-over from before the Houghton Mifflin revision), and the Addison Wesley Alternative set of texts (made available to schools and teachers reluctant to adopt the Houghton Mifflin.). These texts and the audio visual materials which supported the Houghton Mifflin Series constituted nearly the total available materials for teaching math in Brentwood. When the objectives had been published in the Manual for Students and Parents, it seemed necessary to indicate where these objectives were taught; where could be found drill and practice to help sharpen student skills.

Level by level the objectives were matched to the materials (see fig. 18). This booklet now made easy a new approach in which teachers could now start with an objective instead of following text book sequence. Anticipating that teachers in reviewing the tests would request a handy and usable answer key, it was decided to make a booklet which provided each teacher with a complete set of answers for each test item in the program. (see fig. 19, appendix F.) The objective is listed in the column. To the right of

CROSS REFERENCE GUIDE FOR FOURTH GRADE

TEACHER NOTES	OBJECTIVES	HOUGHTON-MIFFLIN 1st. ED.	HOUGHTON-MIFFLIN 2nd ED.	ADDISON-WESLEY 2nd. ED	HOUGHTON-MIFFLIN I C S P	HOUGHTON-MIFFLIN TAPES	HOUGHTON-MIFFLIN FILM LOOPS	SRA DRILL TAPES	EDL MATH MASTERY
	4110	242-244	16,17,20-23,174-175	2-20		I-12	I-3 to I-5	#8	Unit I 3, 4
	4130	16-19	174-175, 320	2-20					Unit I 1, 2
	4140	327		156-157					Unit I 5,
	4150	32-35	8,9	304-308		I-16			
	4160	194-195, 196-197	162,163	236,208, 214	Basic Skills Fractions #9	I-14 I-26			
	4170	198-202, 204-205	164,166, 317	234,236, 237		I-14			
	4180	5,203,318	246,247, 317	232					
	4210	46-49,52	44-45,48	36-40	Addition Skills 7, 8, 9	I-1 , I-3		#2	
	4220	46-47,50, 51,53	42-43, 46-47, 48-53	49-52	Subtraction Skill 8	I-2 I-4		#1, 3, 6	
	4230	118,121, 224-26, 228-29	192-194 222-223	170-184, Chapter 3, 5, 7	Whole Number Multiplication Skills 3, 4,5,7,8	I-8	I-5		
	4240	230-236, 250-252	214-216, 230-232	202-20[illegible] Chapter 3,5,8	Whole Number Division	I-9	I-6	#5, 8	

(fig. 18) - Cross Reference Guide listing Instructional materials by objectives

BEST
BRENTWOOD EDUCATION SYSTEM FOR TESTING
GRADE FOUR
ANSWER KEY 73-74
2nd. SEMESTER

OBJECTIVE	1	2	3	4	5
4140	D	A	B	D	C*
4160	B	C	D	A	B
4170	C	A	B	B	D
4180	A	B	C	A	B
4240	D	C	A	B	C
4250	D	A	B	B	C
4260	D	C	A	A	C
4270	D	C	A	B	B*
4310	A	B	C	D	A
4320	C	D	B	A	C
4330	B	C	D	D	A
4340	A	D	C	B	B
4350	B	A	D	C	B
4360	A	C	D	A	B
4370	B	A	D	C	A
4510	D	A	C	C	B
4520	A	C	C	D	B
4530	D	B	C	A	D
4610	A	B	B	C	D
4640	B	D	B	C	A
4650	A	B	A	C	D
4660	C	D	B	A	D
4680	A	D	D	A	D
4690	A	B	D	C	A
46100	C	C	B	A	D
4730	C	D	B	A	C
4740	B	B	A	D	D
4750	A	B	C	D	A
4760	A	B	D	C	C
4820	C	B	B	A	D
4830	C	D	A	D	B

31 objectives x 4 items = 124 = 2 items*
= 126 items ÷ 6 tests = 21 item test

(fig. 19) - Answer Key

the objective is listed the correct answer for each of the test items developed for that objective.

During the first year one of the BEST team leaders felt a need for the development of practice activities for each of the objectives in the 6th grade curriculum. Working entirely on his own, Mr. William Harris of the Northwest Elementary School, wrote his book of supplementary exercises. (see Appendix J) The Curriculum office was sufficiently impressed with this activity book that it was printed and distributed to all 6th grade teachers. On a visit to our project a member of the State Education Department asked for some copies. Eventually it was duplicated and distributed throughout the State of New York.

Also at the completion of the first year, the committee of teachers and administrators began to compile mastery tests (see Appendix D) for each objective. It was a conscious, deliberate step in the direction of mastery teaching. For each level in our instructional program a set of minimal objectives was defined by teachers and administrators. However,even at the reading of the list, it is clear that some objectives require mastery in the 6th grade. For example - #6210 - The students will select the number which is the correct answer to an addition problem consisting of no more than four 5-digit numbers. This objective should be accomplished at a high mastery level by most 6th graders. Normal 6th grade students should get the correct answer nine out of ten

times.

On the other hand, Objective #6130 -"Student will select a base six number which is the same as a given two-digit base ten number or will select a base ten number which is the same as a given three-digit base six number." is the kind of math problem and thinking that all students should be exposed to. We know that this objective will not be mastered (with retention) by all students.

To determine the level of mastery, tests consisting of many items for one objective were constructed. (see fig. 20) The uses of the mastery test were then developed:

1. to provide information beyond the regular trend test.
2. to check or validate results on trend tests.
3. to determine the regularity with which a student can successfully perform the action called for in a particular behavioral objective.

In addition a variety of charts, graphs and forms have been developed by individual teachers. The BEST Objectives Chart (see fig. 21) was developed by one teacher and requested by many others for making visible the class record against the set of objectives. This chart may be used in either the math or reading program. It lists students and lists objectives. C = Correct - W = Wrong - N = No Response and T = Taught. Since all the information of this chart is produced by the computer for the Individual Analysis report, it seems that there is some other benefit derived from displaying the same results on a wall size chart.

B.E.S.T. MASTERY TEST

04-03-001
OBJECTIVE

STUDENT NAME

TEACHER NAME

DATE

____ 1. WHAT FRACTION IS NOT EQUIVALENT TO 6/12?

(A) 1/2 (B) 4/18 (C) 3/6 (D) 12/24

____ 2. WHAT FRACTION IS NOT EQUIVALENT TO 4/12?

(A) 3/9 (B) 1/3 (C) 2/9 (D) 6/18

____ 3. WHAT FRACTION IS NOT EQUIVALENT TO 6/16?

(A) 3/8 (B) 21/56 (C) 12/32 (D) 6/18

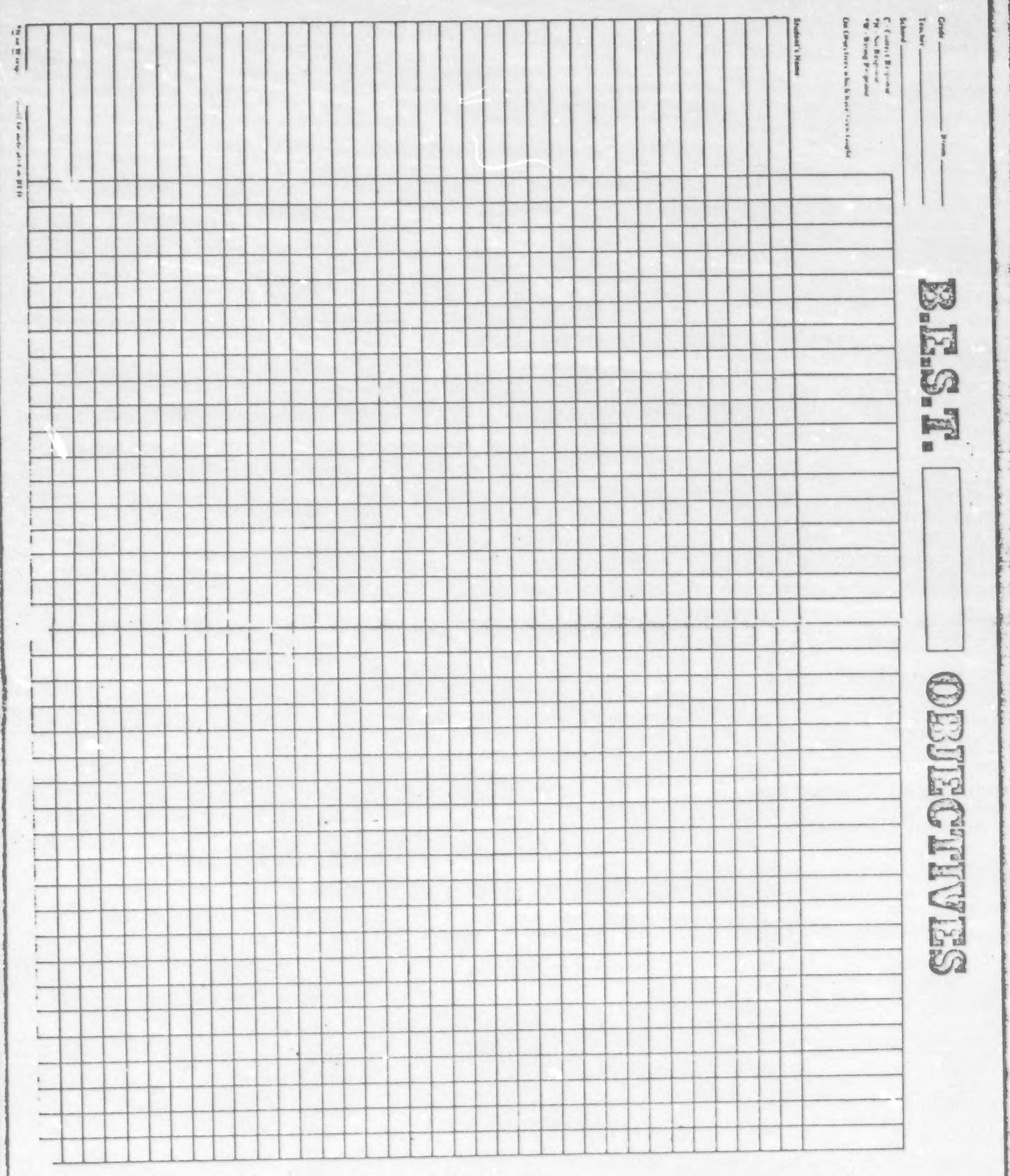
____ 4. WHAT FRACTION IS NOT EQUIVALENT TO 10/20?

(A) 5/9 (B) 4/8 (C) 8/16 (D) 5/10

____ 5. WHAT FRACTION IS NOT EQUIVALENT TO 6/8?

(A) 9/10 (B) 3/4 (C) 15/20 (D) 21/28

(fig. 20) - Mastery Test sample page



(fig. 21)
Class Performance Chart

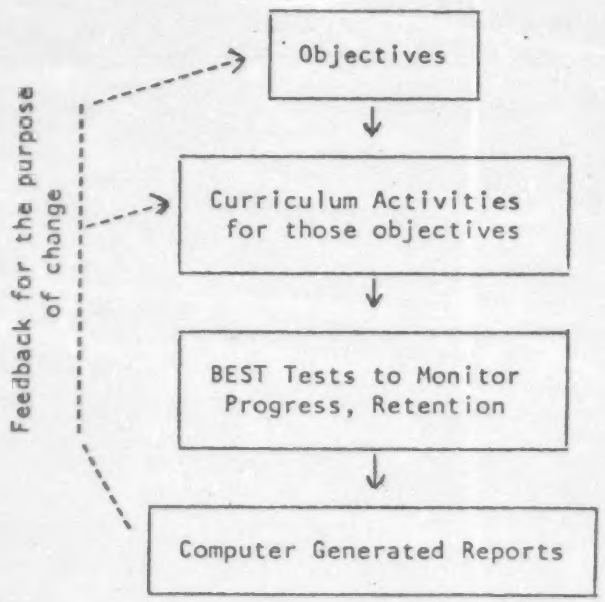
V. How it Works. Once organized the CAM System or the Brentwood variation B.E.S.T., provides the following:

1. A curriculum defined by behavioral objectives, which are systematically coded for identification, retrieval and grouping, and which are further classified by one or more taxonomies.
2. Test items or other behavioral indicators designed to measure student performance on each behavioral objective specified for the system.
3. A set of randomly interchangeable tests, organized so that each test evaluates all or a predetermined sample of all the objectives in the curriculum.
4. Periodic testing, usually weekly or biweekly, throughout the period of the course.
5. Computerized analysis and reporting of results within a few days of each testing.
6. Interpretation of results by teachers and students as a basis for decisions relating to curricula, instruction, and estimating of student progress.
7. Modification of curricula, instructional activities and the CAM design based on the results extending over the course.

8. Reporting of student progress.[4]

In the Brentwood System, the first test in the twelve test sequence is used as pretest. Thi system provides the added advantage of having all results stored in the computer so that the very next test provides information concerning growth, retention and new learning.

As the course progresses, the monitoring system serves to provide feedback to student, teacher and parent concerning progress. It might schematically be presented as follows:


Objectives
Curriculum Activities for those objectives
BEST Tests to Monitor Progress, Retention
Computer Generated Reports
Feedback for the purpose of change

[4] Instructional Module 3200. How Does CAM Relate to Course Structure, William Gorth and Robert O'Reilly, SPPED, New York State Education Department, 1972.

The relationship of the monitoring system to the instructional program is dynamic. The constant flow of information becomes part of the curriculum. It provides a problem detection and self correction mechanism for the teacher and the course.

VI. Using Monitoring Program Information for making Decisions about the Instructional Program. Teachers, principals, students and curriculum directors have to make a long series of educational decisions during the course of a school year. In most cases these decisions are built on intuition, past practice, habit, astrology, superstition and other less scientifically sound methods. Asking the right kinds of questions becomes a major pursuit for those curriculum directors, principals, etc. who have developed an information system to monitor the student's progress.

Some regular questions are:

1. How long does it take?
2. How effective was past instruction?
3. How do materials compare for achieving objectives?
4. How do teaching methods compare for achieving objectives?
5. Which sequence is most effective in achieving objectives?
6. Which test practices are most helpful in assessing progress and retention?

Information from the monitoring system will provide feedback about:

1. individuals
2. groups
3. methods-activities
4. materials
5. times
6. the testing system itself.

After schools decide what they should teach, a monitoring system serves several purposes.

a. It keeps track of how well students are learning and remembering.

b. It provides information for specifying the curriculum.

c. It provides information for comparing effectiveness of methods, materials, groupings, etc. on student progress toward achievement of goals.

d. It provides information for faculty discussion of problems of instruction. It makes team work more purposeful, efficient and productive.

e. It focuses the instructional program by regularly calling to the minds of students, parents and teachers the academic behaviorsthat are being sought and developed.

Information reinforces the professional nature of the teacher's and the schools task. From the three years experience with BEST in Brentwood, a teacher survey (See Fournier Midi, May 1975) clearly indicates that teachers consider the information in choosing the materials, means and methods of instruction. They frequently and regularly report that while the system makes evaluation and assessment of student progress easier, it requires the teachers to make more and more decisions.

A constant flow of decisions about individual students must be made: there must be an assessment of progress toward each ob-

jective; there must be determined priority order for selecting objectives for the individual to work on; there must be established pattern of organizing the class to arrange for opportunity to an individual to work on his own problems.

Decisions about group progress are based on

a. average of percent scores on total tests

b. group percent on each specific objective.

The general curriculum decision about student progress, whether examining individual or group achievement usually is made in one or more of four usual alternatives:

a. The objective may have been too difficult, irrelevant and should be eliminated.

b. Information appears to be insufficient, calling for the addition of objectives to be taught and tested.

c. Timing is inappropriate. That is, that the objective should be rescheduled to appear in some other part of the sequence of curriculum.

d. The tests themselves are faulty and items should be rewritten or replaced.

The information that provides a basis for decision flow naturally from a criterion referenced evaluation system. The information produced by each C.R.T. should include the following minimum:

a. did the student learn the objectives just taught?

b. which objectives will be taught later - which should be pretested? (to determine who needs instructions and who doesn't.)

c. what does the student remember from objectives taught earlier in the course. That is, what is his retention?

From this information a teacher and student can proceed to examine the Reports. The student's report (see fig. 10) gives in graphic detail his performance on a set of objectives that had been specified. In the discussion with the teacher and examination of his own the student gains information which

a. clarifies objectives - only working on them gives a nearly complete account of the behavior expected.

b. immediately reinforces behavior which brought about success for an objective. The teacher's awareness of the behavior and the success or failure make it much easier to decide about rewarding, re-inforcing or helping the student to avoid specific behaviors. In many ways, this activity is like correcting teacher-made tests. However, there is a great difference in the amount and form of reporting pre-instructional, post-instructional and retention behavior.

In making decisions for group or whole class instruction: "How does one go about doing this? By methodically analyzing and interpreting CAM feedback data. The method used involves: (1) detecting logical indicators of progress or a lack of

progress, (2) listing the possible causes, (3) listing the conclusions (i.e., most probable cause), (4) listing alternative solutions and, (5) making a decision concerning what must be done in order to benefit the student--the individual--to help him to learn better (i.e., selecting the best alternative). This applies to "fast" students as well as the slower ones.

If anyone should ask you where, in CAM feedback, one should look for indicators that all is or is not going well, you might answer, 'Everywhere.'

'Everywhere', in this case, includes during the entire pre-instruction phase (pretesting) immediately after instruction and in the entire post-instruction phase.

What are some of the things that can happen during these phases? Well, here are a few. During the pre-instruction phase you may find that the student either already knew the subject or that he learned all or some of it during that phase. A high pretest score indicates one or more of these possibilities.

A low score in the immediate post-instruction phase indicates that either some deficiency exists in the student's learning or the efficiency of the instruction or both. And, a decreasing posttest score indicates diminishing retention. There are many other indicators.

Why any or all of these situations came about is part of the detection--analysis--process. What to do about it is the decision." [5]

[5] SPPED, Instructional Module 3000, New York State Education Dept., 1972., William Gorth, Richard Allen, Robert O'Reilly.

VII. Mastery Testing Component of BEST. Mastery tests, (see Appendix D) are a necessary extension of the trend monitoring. Trend monitoring tests on few (maybe one) items per objective. Mastery Testing tests many items on an objective (5-100 or more). Mastery Testing as indicated by its name tells a lot about a little bit (one objective). The uses of Mastery Testing are:

a. for additional information - student performance on trend tests does not satisfy teacher that student really knows or doesn't know an objective.

b. for confirmation - Teacher wants to know the extent to which the student will perform on an objective. Trend data will give one out of one test item correct or incorrect for any objective.

Mastery test will report 6/8 or 8/8 or 0/8 correct. The teacher gains added assurance about the level of student performance and the reliability of his performance on a particular objective.

In Brentwood, Mastery tests are in the storage rooms or media centers of each elementary school. A teacher aide on demand will run off a ditto of a mastery test. Teacher will administer the test. The aide may correct the test, using the answer key. The results are immediately forwarded to the teacher for instructional decisions based upon both trend and mastery data.

VIII. Implementation of the BEST Program in Brentwood. In 1971 Dr. Robert O'Reilly, Chief of the Bureau of Research and Cultural Affairs, New York State Education and Dr. William Gorth of the University of Massachussetts came to Brentwood for a dinner meeting with Dr. Arthur R. Brieger, Assistant Superintendent and with me, Director of Curriculum K-12. They had a system they were trying to sell the Brentwood Schools and they were aware of many advantages of working in Brentwood. First, the size of the school district. With 22,000 students at that time, Brentwood ranked as largest after the big six cities. Secondly, the Brentwood Schools had developed a reputation for innovation in curriculum. A six-year Ford Foundation School Improvement Grant (which this writer directed in 1966-1967 and 1968) had resulted in the publication of several programs which were distributed nationally.

The CAM system they described seemed hopelessly complex at that first meeting, yet, there was a great appeal in the systematization of information that was offered. Dr. Brieger and I were aware that our scores in reading and math had been declining at a rate greater than the state average. We had also become caught in budget squeezes which forced the elimination of supervisory positions. Our class size was (and is) the largest in the area. Even before we were fully aware of the understanding of the potential of the program, there was an unwritten understanding that if we pursued our interest at all, it would be with the committment of very little

money. We were assured that if we qualified there would be financial support from the State Education Department and from various government sources.

I had been Curriculum Coordinator since 1968. In those earlier years, we had coordinators of Social Studies, Reading, Science, etc. Since those positions had been lost and we still had twenty schools, 22,000 studentsand important curriculum problems, my first inclination was to try to find someone else to pursue the information given to us by Dr. Gorth and Dr. O'Reilly. I went to Albany for further talks with Dr. O'Reilly and he provided me with various descriptions of the system. Slowly the potential for monitoring instruction became clearer and clearer. Though it still seemed difficult to find the time, as I grew to know the program better it became evident to me that ultimately this project was definitely part of my responsibility, and further, an opportunity to improve the instructional program. Dr. O'Reilly's definition of Curriculum as "the set of behavioral objectives" at first seemed an overstatement and yet there was enough of a "truth-ring" to the statement that it discouraged my assigning such fundamental curriculum work to some other administrators. For several weeks I studied the program. I even tried explaining it to other people -- without any success at all. This is when it first became evident that what is really an incredibly simple conception becomes totally tangled in explanation so that the uninitiated usually re-

ceive a message that says something like, "There are so many variables, objectives, computers, numbers, etc. that I'll never really understand this." It was a great relief to discover that only the project manager had to understand all the educational implications and only the computer programmer had to understand all the computer implications. It was entirely possible for people to use the system without understanding the relationships.

Dr. O'Reilly was good enough to arrange for a visit of Brentwood personnel to two New York State school districts which were attempting the program.

Choosing the individuals to go on this trip was the subject of long discussions between the curriculum coordinator and the assistant superintendent. The people selected for the trip were likely to be the people who would try the system if we ever proceeded to that point. It was immediately agreed that all those people who would accompany me would be principals.

In selecting three principals from among fourteen, certain criteria had to be followed.

1. They should be principals who had shown a willingness to innovate.
2. They should be opinion leaders who could influence others to attempt the program, should it succeed.
3. They had to be principals from among our six principals of target schools -- the target schools being defined as

those with students from families receiving aid to dependent children.

If we were to spend any money at all on such a project it would certainly have to come from ESEA Title I funds from the Federal Government. Given all the needs and restrictions, three were finally chosen. The first choice had been a math specialist for training teachers when we had Ford Foundation money for modern math. The second was a long established principal who was a known opinion leader. The third was new to our district but with many years of experience in other districts. He often had demonstrated a willingness to innovate. Each was approached. The program was explained but there was sudden surge of enthusiasm for the idea of a monitoring program. However, they agreed to go to Ballston Spa and to Greece, New York.

On this trip, the decision to go ahead and attempt the program was really made, though it took Board of Education action at a later time to make it official. The first school was visited - Ballston Spa Middle School. It would have been difficult to find anything that resembled our own school district less. It was a very large, modern, expensive building to house grades 6, 7, and 8. It was constructed for large group, small group and individualized instruction in open space. The various areas were brightly decorated. The staffing patterns were even more removed from our experience. A team leader, or grade leader worked with other members

of the staff to develop objectives in each subject. Tests were constructed. Upon completion of units students were directed to the test area where tests were administered and scored by aids. CAM tests were sent to the Data Processing Center which produced the reports for each individual teacher. Everything seemed to be working very well and yet the impact on our group from Brentwood was negative. Everything was so new and expensive; so much manpower was available that it seemed to us that these must be the factors that made CAM "go" in this school district. It was fortunate that Dr. O'Reilly had arranged for us to visit Greece, New York as well. In Greece, we still found a better personnel situation than we could have. Yet the project seemed to be getting started in this district which in many ways was not too far removed from our reality. The teachers and administrators we talked to were very positive about this program for improving student performance. On the way home, we discussed how we go about giving it a try in Brentwood.

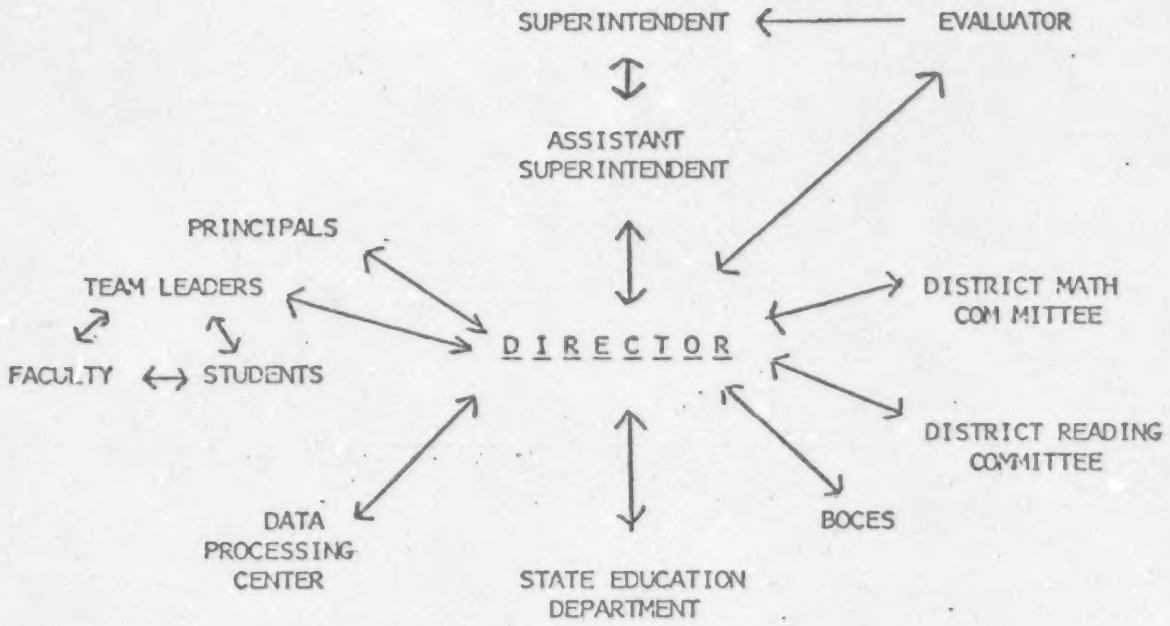
The natural step was to get permission to have some people trained in Comprehensive Achievement Monitoring. It seemed natural and necessary to include teachers in each of the three buildings where the program was to be tried. Just as naturally we thought of those three teachers as the team leaders to help initiate it in each of the schools. The same prerequisites seemed to apply to the teachers who would help this program succeed. They needed to be innovative and to be opinion leaders in each of their buildings.

Once the teachers were selected, all six people went to a one week workshop at the University of Massachussetts. Dr. William Gorth conducted intensive, all day programs which described, demonstrated and simulated the CAM operation. Our three principals and three teachers returned to Brentwood , authorities in monitoring instruction. At this point we had enthusiasm and knowledge and nothing else. Yet, we decided to implement the program. In order to implement the program we would need objectives, test items, tests, guides, answer sheets, etc. etc. To get organized for producing and later carrying out these tasks we described the following organization. (see fig. 22)

It was decided that the Director of Curriculum would be the project manager. The director would report to the assistant superintendent who in turn would report all phases except evaluation to the superintendent. The administrator for evaluation (at that time on staff for ESEA) was to report evaluation directly to the superintendent. The director would assume responsibility for all relations: Internally with principals, team leaders, central office, students, district curriculum committees, Data Processing Center and the State Education Department.

At this time we also carefully defined the team leader's role. (see fig. 23) The team leader would carry on direct liaison between faculty and principal. He would conduct in-service workshops for interpretation of data and explanation of process.

PROJECT DIRECTOR'S ROLE

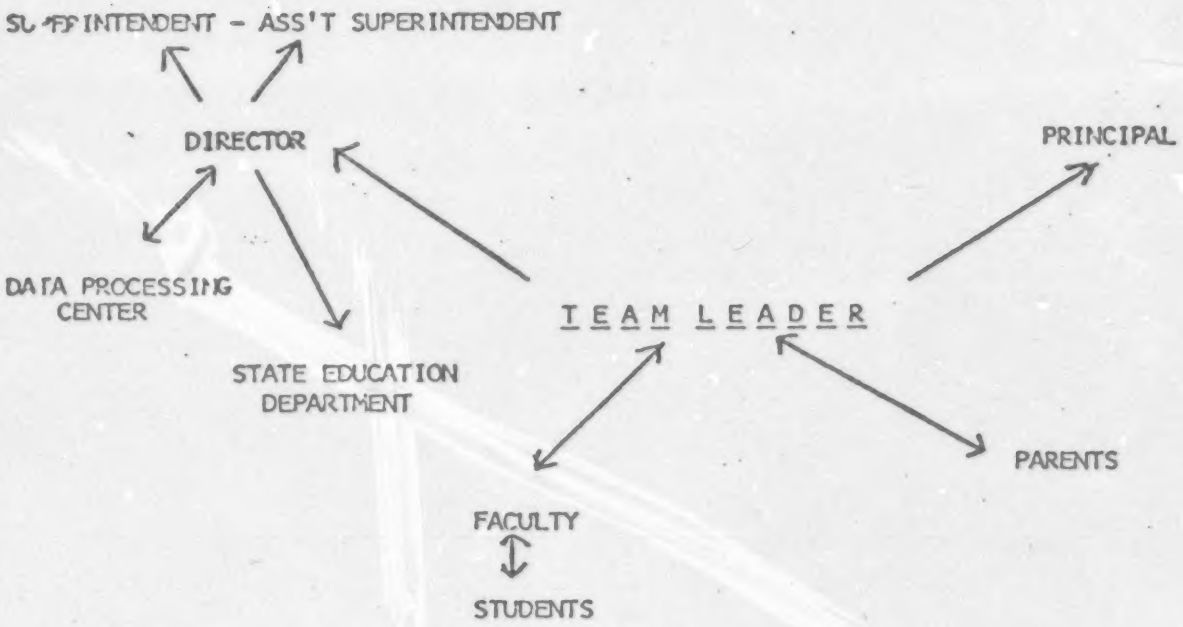


ADDITIONAL DIRECTOR DUTIES:

1. SCHEDULES FOR TESTING, REPORTING.
2. CONDUCT MEETINGS - AGENDA, MINUTES.
3. REPORT TO BOARD OF EDUCATION AND PUBLIC.
4. ASSIST SCHOOLS
    A. IN SERVICE FOR FACULTY
    B. ORIENTATION FOR PARENTS
5. SUPERVISE PRODUCTION TO QUALITY CONTROL
    A. OBJECTIVE
    B. ITEMS
    C. TESTS

(fig. 22) - Chart illustrating relationships for project director

TEAM LEADER'S ROLE



ROLE:

1. PROVIDE TESTS, ANSWER SHEETS AND PRINT OUTS FOR TEACHERS AND STUDENTS.

2. LEAD TEST PERIOD DISCUSSION WITH STAFF FOR:

   A. ANALYSIS OF DATA
   B. STRATEGIES FOR CHANGE
   C. MATERIALS, PRACTICES
   D. ON-GOING RECORD OF DEFICIENCES IN OBJECTIVES, ITEMS, TESTS
   E. ATTEND MEETINGS AT DISTRICT LEVEL TO SHARE CONCERN, MATERIALS, PRACTICES

(fig. 23) - Chart illustrating relationships for team leaders

On their return from the University of Massachusetts, the three teachers, now team leaders and three principals began an intensive effort to produce the material needed for testing in the coming year. We stockpiled all available banks of objectives and test items for them to work with. The IOX bank; The Downer's Grove, Pa. bank and the State Education Bank were all very useful. However, the work done in Greece, New York was more helpful in the initial trial. One of the early and key decisions made was to test the existing curriculum rather than revise it. To do that, the members of the team went through our text books activity by activity to find the objective that should be implicit in each exercise. Once listed by grade level the task became the writing of at least five test items of equivalent difficulty, reliability and difficulty. Since a great many math tests were available and since given a model in 4th, 5th and 6th grade math test items, similar items can be produced in great profusion. This part of the task proceeded smoothly. None of the teachers who would use this monitoring program had (to our knowledge) ever heard of such programs. Therefore, it became necessary to write a guide for teachers to help them use the material. Students and parents also had to learn so a guide would have to be provided for them as well. Together with answer keys and tests, all the material would then have to be coded for the computer.

In September, a joint faculty meeting was held for the three

schools who were going to participate in the program. A team from the State Education Department came to conduct an introductory sentence. About half of the 4th, 5th and6th grade teachers attended. The attempt to explain the CAM system in an hour and a half was too ambitious. It was a very warm day in the cafeteria of Northwest Elementary School. Teachers quickly became impatient with the complex systems that were being presented schematically on acetate after acetate.

This was to have been the "kick-off", the initial step in an in-service course of about fifteen hours for training teachers in Comprehensive Achievement Monitoring.

When this session was concluded, I held discussions with other teachers, principals and team leaders and members of the Bureau of Research and School Affairs. With little support, I made the decision to omit, eliminate, skip and otherwise avoid the in-service education part of the preparation for and implementation of CAM. This turned out to be a key decision for many reasons. It was made for the following reasons:

1. I knew there was a national objection to accountability developing in teacher groups.
2. I knew that a previous attempt to implement this program in another large Long Island School district had been rejected after extensive in-service education.
3. I believed (with Socrates and Dewey to pick some desirable

company) that the teachers would quickly and almost effortlessly learn the system if they would only administer the tests and then work with the students to interpret them.

This is the way it has developed. We now have hundreds of teachers who really are qualified in operating with a monitoring system. They became qualified by getting and using information in a very basic, immediate way. They might fail on an exam question about the technique for randomization of student groups or test items (which our computer operator has to know) but that has nothing to do with helping their students learn. Now that the program has been operating successfully for three years with hundreds of teachers and thousands of students I often look back to this as one of the most important decisions contributing to the program.

Obtaining Computer Services: Though Brentwood had a computer since 1968, there practically was no instructional applicators made. It was used for payroll, scheduling, and report cards. The Bureau of Research made some contacts to provide us with computer processing of the program. For a charge of 25¢ per pupil they were to put up the banks of information and generate reports for our schools. At several early meetings the inability of technecians and educators to communicate nearly aborted the program. The quality of the personnel which represented Grumman Data Systems was probably intimidating to public school people. Some of them had just completed work on government contracts which included the "man on the

moon" project. A great deal of patience eventually prevailed. A set of forms was devised and objectives, items and student information were painstakingly coded for the computer. One early problem to manifest itself was that of the 20 mile distance between Grumman Data Systems and Brentwood. The telephone was often inadequate. Much time was taken by driving. Eventually all of the information had been put up on the computer and print-outs were delivered for proof reading. Here we began school districts real introduction to "quality control" because even when we proof read carefully, mistakes were made in the correction and coding process. These mistakes, of course, returned in the final tests and student lists. But in early October, we were ready to test, we thought.

The First Test: In this first trial there was an answer sheet provided to each student but the student had to print his own name, number, teacher name and number and homeroom etc. Then he would take the test. Special IBM pencils were required for marking these forms. When the students had completed the tests, the answer sheets were collected and taken to Grumman Data Systems for scoring and reporting. We awaited the results which were supposed to come in 48 hours. The first test took more than a week and when the results became available we recognized that many problems had yet to be solved. The most important problem was accuracy. Several things, it seems, have to go wrong when 4th, 5th and 6th grade students write down information by hand to be copied by key punch

operators.

a. they make mistakes

b. some of them have handwriting which defies anyone's reading skill

c. some key punch operators make mistakes.

As long as we worked with Grumman Data Systems we never really solved this problem. Through careful checking by team leaders and aids, we reduced the numberof errors.

We neverhad enough IBM pencils. They disappeared at amazing rates. We cut them in half to double the numbers but still couldn't keep up.

Meetings were held to try to improve quality control. It did improve but never to a satisfactory level.

The turnaround problem threatened the program most severely. There is a need for immediacy in returning results for teacher and student's use. Last week or two weeks ago seems much too remote.

Despite numerous little and big events that were not supposed to occur but did with regularity, the teachers and team leaders maintained a positive attitude about monitoring. An important factor may have been that coupled to the complete omission of in-service instruction we had repeatedly announced to the teachers that the program probably wouldn't work. We told them that our expectations for the first year were that we would learn to give the tests and interpret the results even if those results were not

what they should have been. This approach was taken because we had had sufficient experience with programs that promised magic cures that we decided to minimize expectations so that any real productivity in the program would be viewed as a pleasant surprise. Describing the possibility of failure and the expectation of much less than total success helped us with the faculty. They appreciated candor and realism in educational innovation.

Throughout the period the State Education Department maintained its involvement with us. They had contracted Dr. Shelly Harrison of Technovations (Later - Public Systems Research) and Stony Brook University to be a liaison between the Brentwood Schools and Grumman Data Systems. Members of Dr. O'Reilly's staff visited regularly. The Bureau had contracted Dr. S. Alan Cohen (later author of Random House High Intensity Program) to develop objectives and test items in reading. A steady stream of preliminary work in reading kept flooding the curriculum office. The math monitoring program was being praised by students and teachers and it seemed desirable to monitor reading as well since our scores had been declining. Besides, we now had a staff of teachers and team leaders trained in monitoring system. The system would be the same no matter what subject was monitored. By the Spring I had announced that two schools would begin monitoring Behavioral Objectives in reading. The Bureau of Research had promised an extensive set of objectives with many validated test items for each objective.

It was, to hear it described, merely a matter of choosing the material and installing the system.

Also in the Spring, at the conclusion of the first year, Grumman Data Systems announced that its rate would increase from 25¢ per pupil to nearly 60¢ per pupil per test. Since we were planning to test in reading as well, this would have meant the cost of $1.20 per pupil per test period, if students were in both programs. This was more money than we were spending on text books and supplies. Since we couldn't really affort the twenty five cents charge in the first place, the new cost was absolutely out of the question.

In discussing this latest problem with Dr. Harrison, he informed me that his organization, Technovations, could, for $4,000.00 program our district computer to perform the monitoring tasks at much less than 25¢ per student.

Simultaneously, in soap-opera fashion, Dr. Nannini, the Superintendent, announced his resignation effective in June. Dr. Nannini was reluctant to authorize the programming because he thought that such a decision should be made by the new superintendent. However, if our computer was to be programmed by September, Immediate signing of the contract was necessary. I signed the contract without authority to do so. My assumption was that improved student performance would mitigate in my favor, if not justify the act. Dr. Harrison and his crew from Technovations began the work

in the summer. From the beginning, Mr. Joseph Rotolo, the school district's Coordinator of Data Processing said that the program in Fortran II would

a. be too slow

b. not allow for all the students that Brentwood would have to put in the program if the program were to succeed in both math and reading.

In the meantime, Mr. Di Pietro was made Superintendent. I knew that it would generally be his view that anyone who committed the school district to a $4,000.00 contract without authority should be fired -- not an altogether unreasonable point of view.

To compound the difficult and complex, I received a telephone call from Dr. O'Reilly informing me that the objectives and test items and financial support would not be available for installing the reading program to which I had committed myself, the district, and the Data Processing Center. If the first year of CAM math testing had gone well, it's ending promised to be an academic, social and personal disaster.

Things could hardly have been worse, since there was also a recession and a shortage of jobs that Spring.

In the Spring of 1972 the District Reading Committee was ready to make its recommendation to the District Curriculum Advisory Council - the Curriculum Coordinator is chairman of this council which recommends programs and materials to the superintendent of

schools. This program carried a set of behavioral objectives in reading comprehension. Even with this adoption there would not have been sufficient time to write all the test items. However, a strategy for extrication began to form. I called the salesman to my office and told him that I had heard that the reading committee was going to recommend his series for adoption in Brentwood. He indicated that he had heard similar rumors himself. I then explained to him that as chairman of the Curriculum Advisory Council I couldn't possibly allow such a recommendation to be heard, much less sent to the superintendent if the program was not accompanied by four test items for each objective. He took the news well and recovered quickly. He called his main office. There a vice president called an editor in Denver and within an hour there was an agreement to provide test items if the program was recommended by the Reading Committee, the Curriculum Advisory Council and the Superintendent. Now there was a slight hope that the reading monitoring program could be delivered as promised. In the meantime, the original CAM math team was going to work for two weeks to rewrite objectives and test items which had demonstrated flaws in the first year. This was to be a major strength of the program, that in a period of time from constant rewriting there would emerge a program completely tailored to the needs of our school district.

As the first bill from Technovations came due, I arranged for payment with ESEA money that we had planned to use to pay Grumman

Data Systems but that amount was now exhausted and no provision had yet been made for the final payment.

By the end of the summer the publisher, true to his bargain supplied four test items for each objective but they were not in usable form for monitoring program purposes. Their chief defect was that nearly every item required multiple behaviors on the part of the student. In a panic the last week of the summer I began to rewrite the test items. For the next six weeks I wrote every day. In early September we began coding the math for scoring on our own computer.

Another bit of rescuing as the Federal Projects Evaluator informed me and the Superintendent that the students in the monitoring program (see evaluation section) had in fact made greater gains than the Control Group. This publication gave added impetus for going on with the math program. After publication of the results, I submitted the last bill to the Superintendent with a long explanation which he accepted. However, many of Mr. Rotolo's predictions came through as we were through the first semester without testing in reading.

The program on our own computer was slow. We were not getting the rapid turn around we had been promised. The program worked only with regular attention from the staff of Technovations. Around mid-year of the second year of CAM (Renamed B.E.S.T. by Dr. Harrison as he programmed the computer) Mr. Rotolo informed us

that if he rewrote the entire program, using COBOL computer language we could enter all our elementary students in at least four programs with over-night turn-around if tests were carefully scheduled.

At about this time dissatisfaction with slow turn-around, errors, lack of reading program had caused principals and team leaders to be less confident of the programs future. By now, though, the Superintendent had become an ally of the program. He called a meeting attended by all interested parties in which the following agreements were made:

1. Rewrite program in Cobol
2. Try reading in grades 4, 5 and 6 in two schools as soon as possible.
3. Set a schedule for spreading program to all fourteen elementary schools in an orderly fashion as long as improved student performance justified the effort.

Dr. Harrison and his crew were finally ready to put up the banks for reading monitoring in early Spring. Two principals who had served on the BEST reading committee were ahead with installation in their schools. The reading consultants became the team leaders. Again we used many of the strategies which seemed to work in Math. We conducted no in-service workshops. We allowed the teachers to learn to use the system by using the system. A preliminary evaluation after only a short trial was very positive about the effects of BEST on student achievement.

We concluded the year on a very cheery note compared to the feelings of the preceding summer. The teams were again organized to rewrite and refine the program. One major change was needed though; we could not expand the program with the program installed by Technovations. Mr. Rotolo now proceeded to write and install his own COBOL version of the program. This work went on all summer.

In the meantime, the reading team of teachers and administrators were writing manuals (see Appendix K), guides for parents and student, cross reference guides (see Appendix L) for materials, reading objective bank (see Appendix M), test items bank, (see Appendix N), and tests (see Appendix O).

In rewriting the computer program, Mr. Rotolo developed another refinement. The computer would now print all tests on dittos (see Appendix O) for distribution to the schools. This would now take us out of the printing business---which was a rather large part of the effort. High school girls and other temporary help were recruited to do all the coding for entering the millions of bits of information for both the reading and math programs.

We began year three of the program very enthusiastically. There were slight delays in testing as final computer adjustments were made.

Right from the beginning the new program worked with an ef-

ficiency that was a marvel for everyone who was involved. Tests were scored and reports produced overnight. Test answer sheets collected by two o'clock in the afternoon brought all reports back to each school by nine o'clock the next morning.

Another feature that Mr. Rotolo built into the program solved 90% of our quality control problems. It was the printed answer sheet (see Appendix P). The computer printed an answer sheet for every student with all information (names,numbers, sections, etc.) except the answers to the test items. The only writing now done by students was the simple mark sense fill-in. The Brentwood Op Scan also permitted the use of regular #2 pencils - solving another test problem.

The program went so smoothly that by mid-year the decision was made to add two schools to the math testing program and in addition to add the reading testing program in the original BEST math schools. Studies covering student progress in each of the subject were in progress. The biggest success of the program was now readily evident as parents came to meetings to learn how to interpret the test results that their children were now regularly bringing home.

In the Spring I participated in a statewide workshop in Albany to describe CAM and interest other districts. Brentwood had succeeded in developing a full computerized monitoring system in math with state cooperation. Beyond that, on its own, Brentwood had developed a reading monitoring system. At this writing in 1975, Brentwood is still the only district in New York State with a full monitoring

program, completely computerized in reading. The Curriculum Coordinator and members of the Brentwood staff have now entertained hundreds of visitors. We have gone to many other school districts to help them implement math programs. We have provided our objectives and test items to help people get started in reading as well.

The hypothesis that this program would help students achieve better results in math and reading has been confirmed. (See evaluation section)

An added bonus has been the affect development brought about by focusing on instruction. Letting everyone know what we are trying to do and letting everyone know how he individually is succeeding seems to serve as an important motivational device.

As I once remarked to a teachers group, no one has ever met a person who gets up in the morning and says to himself, "Today I'm going to do a rotten job." But for some of us it works out that way because we don't have enough information about the kind of job we are doing. Providing information, or feedback as our computer specialists choose to call it, makes possible the regular course correction for both teacher and student.

IX. Evaluation. To quote Dr. Daniel Stufflebeam, "Evaluation is in fact a process which can provide key inputs to aid planners and decision makers in making necessary decisions. Evaluation inputs can provide these data not just at the end of a project or activity but throughout all stages, from initial 'drawing board' stages through operation or implementation to termination or long range continuation."[6]

This definition has probably never been more applicable to a project than it is to our experience with BEST - CAM - (BEST is the Brentwood variation of Comprehensive Achievement Monitoring)

Context Evaluation

Q. Why did we need a monitoring system?

A. Because student performance had shown a regular decline.

Q. How much could we afford?

A. Little. (see Budget) We financed through ESEA.

Q. How much could we commit to long term expense for maintaining the program?

A. Little. (see Budget)

Q. What experience did we bring to the project?

A. Extensive work in curriculum development. (see Implementations)

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[6] Stufflebeam, Daniel, "The Process of Evaluation An Easy Example" Unpublished handout distributed at Cluster meeting in Education, undated.

Q. What was the monitoring system that was needed?

A. One that would perform clerical task and provide usable information. - CAM only one available which met the criteria. (see Problem)

Input Evaluation

Q. How long did we have to find a solution to declining scores in reading and math?

A. We needed a solution as quickly as possible. The downward trend was threatening to become a collapse.

Project Plan and California Test Bureau's diagnostic math and several other systems were compared. None met the criteria set in the Context Evaluation. The input and the context evaluations both suggest a rapid move.

Process Evaluation

From the very beginning BEST was an outstanding example of an innovation which produced its own regular process evaluation for individuals and groups (see Program). It even produced item analysis (see fig. 24) and error analysis (see fig. 25). By definition this monitoring program is Process Evaluation.

Product Evaluation

In October 1974 I testified before a Panel of the New York State Office of Performance Review (Rockefeller's Klepak Commission watchdog on education). The Commission task was to evaluate testing procedures in New York State. In my presentation, I made as

ITEM ANALYSIS FOR MATH AS OF 21/11/73

ITEM	NO RES		CHOICES A		B		C		D		E	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
1050100101	30	0	3	5	6	4	8	7	140	142	1	0
1050100102	29	3	40	39	17	11	110	79	3	4	1	0
1050100103	20	1	41	22	103	80	9	5	20	16	0	0
1050100104	32	14	12	3	121	98	15	11	5	10	0	0
1050100301	37	4	20	18	36	35	91	71	17	8	0	1
1050100302	28	3	122	100	14	10	12	4	19	11	1	0
1050100303	20	2	50	24	13	14	96	79	23	14	1	0
1050100304	21	3	123	102	11	7	17	11	11	15	0	0
1050100401	25	0	29	5	53	12	66	26	92	12	1	0
1050100402	32	0	64	26	93	16	66	15	27	7	0	0
1050100403	33	0	32	11	25	6	115	28	80	7	1	0
1050100404	24	0	125	12	47	30	52	8	28	10	0	0
1050200101	19	0	11	6	9	5	36	9	142	99	0	0
1050200102	17	1	12	8	161	92	13	5	11	1	0	0
1050200103	15	1	7	3	13	3	162	91	17	10	1	1
1050200104	12	0	3	3	10	3	16	0	178	113	0	0
1050200201	27	2	6	1	144	76	43	16	4	4	1	0
1050200202	15	1	17	2	10	3	174	80	22	12	0	0
1050200203	21	1	158	86	33	7	7	2	5	1	0	0
1050200204	31	2	47	21	19	3	10	2	129	81	1	0
1050200301	33	2	20	4	43	7	114	42	46	11	2	0
1050200302	29	2	26	6	39	9	42	5	111	47	1	0
1050200303	36	3	117	55	49	5	24	4	49	4	0	0
1050200304	48	4	35	4	121	54	39	4	23	4	2	0
1050200305	31	3	18	1	131	85	60		30	1	0	0
1050200401	74	6	34	5	72	10	41	7	65	22	0	0

(fig. 24)
Item Analysis - Math

STUDENT PERFORMANCE ANALYSIS BY CLASS DATE : 04.

TEACHER NO: 534
COURSE NO : 000
SECTION NO:- 01

SUBJECT : MATH
SCHOOL NO: 03
TEST NO : 3

OBJECTIVES

| STUDENT-NAME | | 1 1 1

strong a case as I could for the use of Criterion measures to judge student success. We had amassed impressive statistics in Brentwood to support this point of view. The most appropriate product evaluation is the following statement that I made on the behalf of the Brentwood Schools at opening hearings held by the Office of Education Performance Review for the New York State Legislature. The statistics were compiled by Mr. David Holt, Administrative Assistant for Evaluation.

STATE OF NEW YORK
EXECUTIVE CHAMBER
OFFICE OF EDUCATION PERFORMANCE REVIEW
STATE CAPITOL
ALBANY 12224

HELEN B. HOUSE, ED.D.
ASSISTANT DIRECTOR

September 24, 1974

Dear Dr. Fournier:

Thank you for agreeing to participate in the public meetings on pupil testing sponsored by this Office on October 3 and 4, 1974 in Albany. The meetings will begin each day at 9:30 A.M. because of the large number of individuals speaking.

We have scheduled your presentation for October 3 between 3:30 P.M. and 4:30 P.M. Following your formal statement the panel members may want to discuss some of the points you raise. Please bring eight copies of your statement with you. Enclosed is the schedule of speakers. Observers are welcome to attend.

The meetings will be held in Senate Hearing Room A in the Legislative Office Building (corner of State and South Swan Streets). Enclosed is a map showing the location of the building. Please use the State Street entrance. One of our people will be in the foyer to greet you.

If you have any questions, don't hesitate to call me at (518) 474-3342 or 474-3170. We are looking forward to your participation.

Sincerely,

Helen B. House

Dr. Raymond Fournier
Director of Curriculum
Brentwood Public Schools
Third Avenue and Fourth Streets
Brentwood, New York 11717

Brentwood Union Free School District

BRENTWOOD, NEW YORK 11717
(516) 435-2123

Daniel Klepak, Director
Office of Education Performance Review
Albany, New York

REPORT ON THE IMPACT OF BRENTWOOD'S

CRITERION REFERENCED TESTING PROGRAM

Submitted by:

Raymond Fournier
Curriculum Coordinator

G. Guy DiPietro	Superintendent
Arthur R. Brieger	Assistant Superintendent
Raymond Fournier	Curriculum Coordinator
David Holt	Administrator for Evaluation

In 1971, the Brentwood Schools began a trial of Comprehensive Achievement Monitoring in cooperation with Dr. Robert O'Reilly and the Bureau of Research and Cultural Affairs. Comprehensive Achievement Monitoring, most simply described, is a system for

a. specifying the learning expected from the student during a semester.

b. testing the students six times during the semester.

c. reporting to parents, students, teachers and administrators the progress that is being made and the degree in which the learning is being retained. Using the computer to score tests and compile reports made it possible to handle the mass of information.

There were many reasons for this move. First, and most compelling, is that despite curriculum reforms, a variety of supervision strategies, materials changes, and student groupings, children in our schools were not making satisfactory scores on norm-referenced tests. We were in a situation in which we didn't seem capable of changing student performance on norm-referenced tests, yet we believed that we could teach children to read and perform in mathematics. Our experience with norm-referenced tests was confirmed by similar frustration in school districts like ours throughout the country.

The Brentwood Schools have more than 21,000 students in grades K-12. There are twelve (12) elementary schools, a 7th grade center, four (4) junior high schools and one (1) high school. Students in grades 7, 10, 11, and 12 are on double session.

Brentwood's assessed valuation per pupil is the lowest in its area. Even with a high rate of state aid, Brentwood spends less per pupil than neighboring districts. The student population is 77.9% White, 5.8% Black and 15.8% Spanish surnamed.

Target Schools 14.5% aid to dependent children

10.5% Black

28.8% Spanish surnamed

Criterion referenced testing is direct and straightforward. The task and performance expected are specified. The following example is from our 6th grade program:

06-05-004-00 Finding averages of whole numbers

OBJECTIVE: Students will select the correct average number of any given set-up to five whole numbers.

EXAMPLE: A student received on five tests the following grades: 70,90,80,85 and 100. What was his average grade?

(A) 90 (B) 80

(C) 70 (D) 85

First Semester

If the task is appropriate, success is achieved when the student solves problems of this kind. Being above or below the 50th percentile in some part of the California Achievement Tests is rather irrevelant to the teaching and learning task involved in this mathematics objective.

Starting in 1971 we specified objectives and tests in Mathematics for grades 4, 5, 6. In 1972 we developed objectives and tests for reading at the elementary level. We distributed the objectives and sample test items to students and parents. Computer reports on student performance were provided to teachers, students and parents.

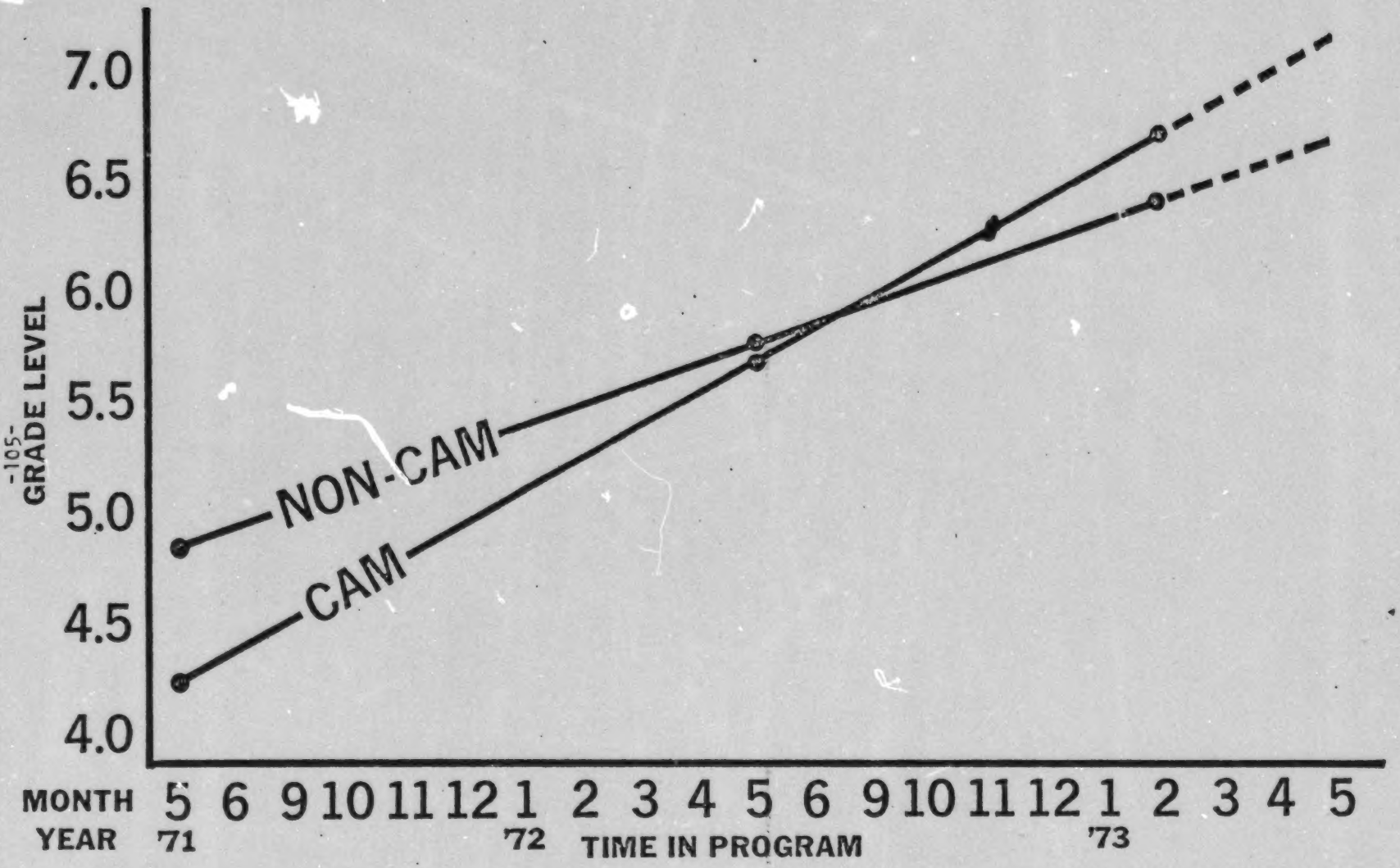
Students worked toward the objectives, and criterion tests indicated that they were succeeding. Performance improved from test to test in both math and reading. Teachers, parents and principals reported satisfaction that students were learning. Materials and activities were being organized to help students achieve the objectives.

Still the questions were heard, "How will they do on norm-referenced tests?", "How will they compare to the norm?"

It is somewhat a surprise that students working in criterion referenced instructions have regularly improved their performance on norm-referenced tests since 1971. It places us in the position of using norm-referenced testing as validation for criterion referenced instruction. The dilemma occurs because criterion referenced instruction defines success as the performance of the task while norms define success as a position relative to other people who took the test.

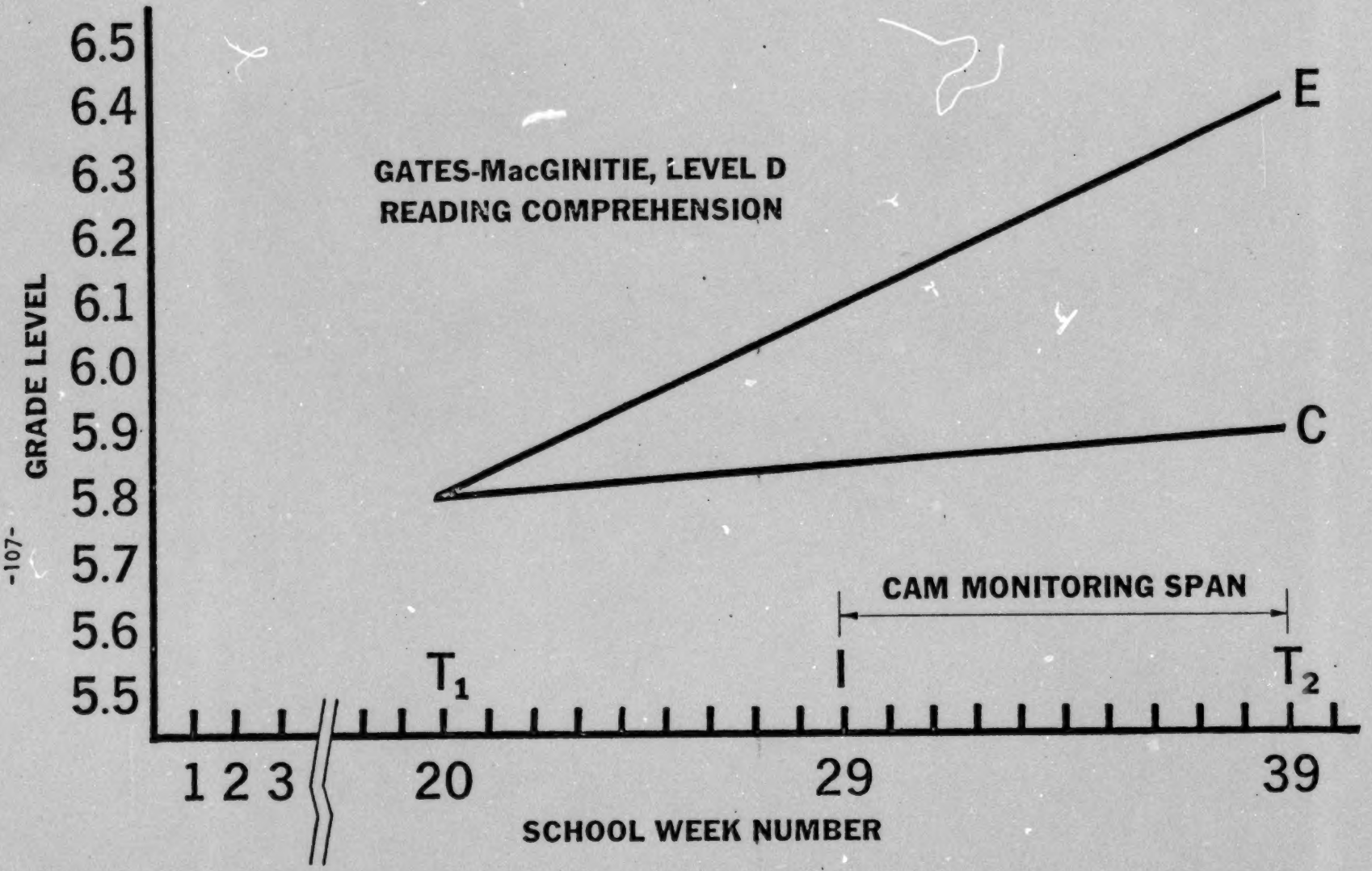
While using the data from norm-referenced tests to demonstrate success of our criterion referenced instruction, we are uncomfortable because it may be implicit recognition of the power and acceptance enjoyed by the norm-referenced tests. Yet, the fundamental flaw of norm-referenced tests is that only one-half of the population can succeed by being above the 50th percentile. One-half must fail, regardless of the instruction. Regardless of the tasks that students can perform, one-half the population must be below the 50th percentile on these tests.

CHART I is a comparison of mean scores of children in the three ESEA target schools having a student population that is most seriously disadvantaged to the mean scores of the other three target schools. The test used in the comparison is the math computation subtest from the California Achievement Test, Level 3, Form A, 1970 edition. The complete math and reading tests were given to the children in all elementary schools in grades 4, 5 and 6 as part of the Districtwide testing program during May of 1971 and 1972 and February 1973. The graphs reveal that although the CAM group was significantly below the non-CAM group in May of 1971 at the end of grade four preceding the introduction of CAM math, by May of 1972 the CAM group had pulled abreast of the non-CAM group at the end of grade five. As sixth graders, the CAM group had pulled away from the non-CAM group, and although the difference was not quite significant in February, a significant difference was projected for the end of the year.



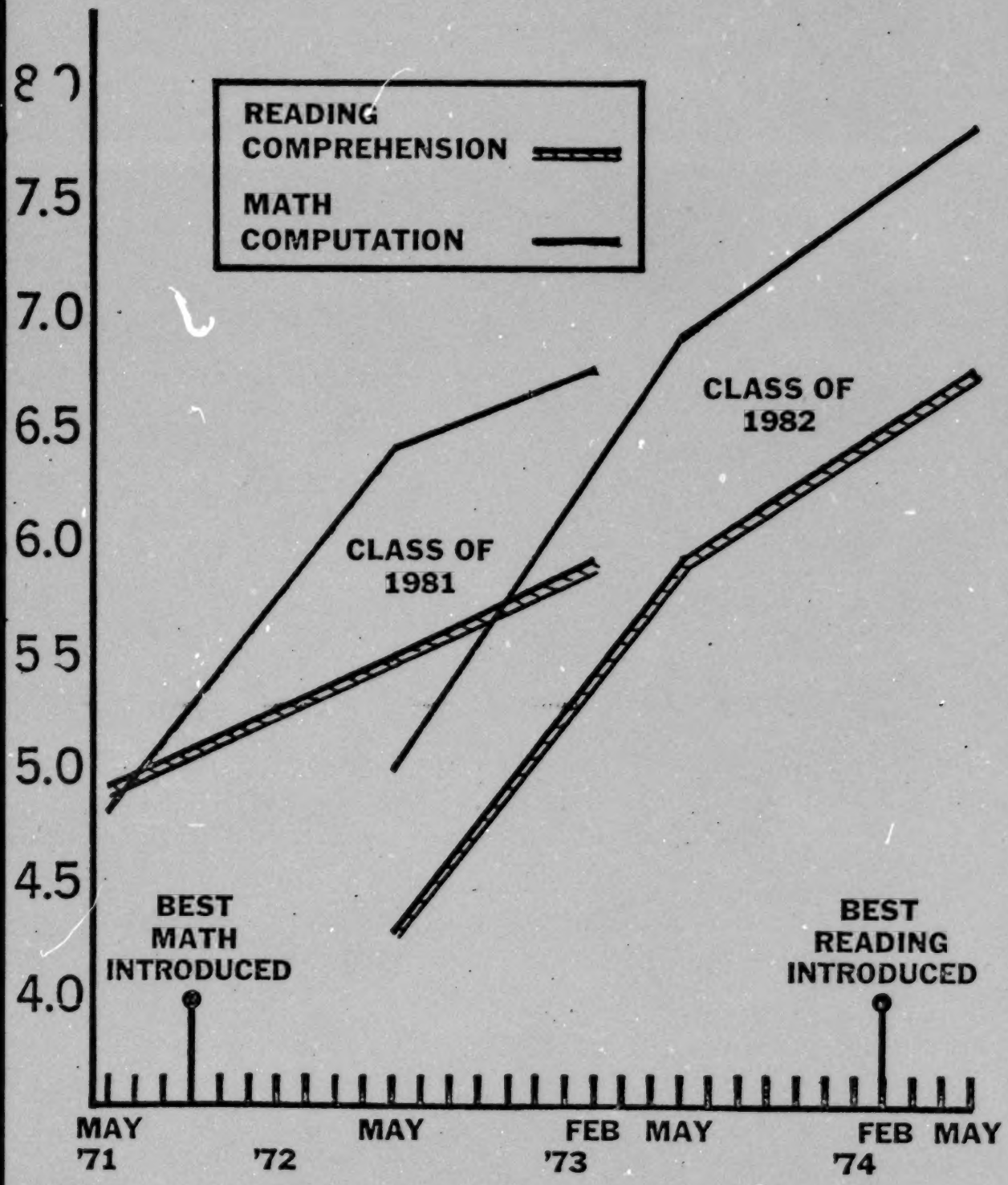
A THREE YEAR COMPARISON OF MEAN SCORES IN MATHEMATICS COMPUTATION FOR CAM AND NON-CAM PROJECT SCHOOLS ON THE CALIFORNIA ACHIEVEMENT TEST

CHART 2 is a comparison of a sample of students from a control and an experimental group in one school that introduced CAM in reading in March of 1973. The Gates-MacGinitie Reading Test Level D, Form 1 was given as a pretest at the end of January, and Form 2 was given as a posttest at the beginning of June. Although the CAM was to begin the first week in February, several problems delayed the start until the last week of March. Only forty-two instructional days elapsed between the first CAM test and the last CAM test. After initial differences between the two groups due to chance variation were equalized through analysis of covariance, the posttest means were compared. As shown in the graph, the experimental group improved their reading comprehension more than the control group. When the adjusted pottest means were compared, the difference approached statistical significance with a probability of .075. This means that there is less than eight chances in a hundred that this difference could be due to random variations in children's test scores.

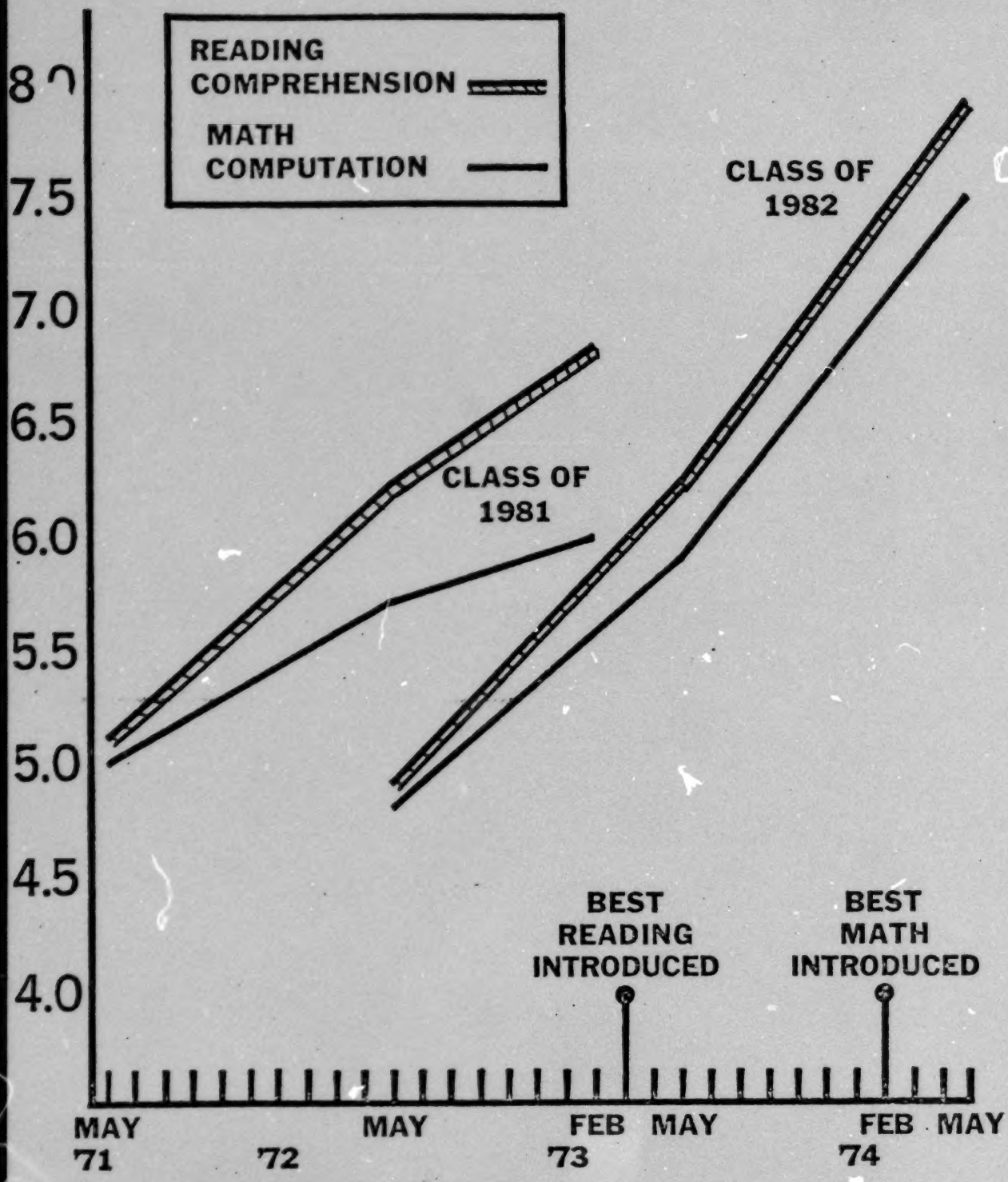


MONITORING SPAN WITH PRE-TEST AND POST-TEST MEANS ADJUSTED TO ACCOUNT FOR PRIOI DIFFERENCES IN EXPERIMENTAL AND (NTROL GROUPS IN BEST READING 197:

CHARTS 3 and 4 show the progress of 2 classes through grades 4, 5 and 6 in their performance on the California Achievement Test - Reading Comprehension and Math Computation. Chart 3 is for Twin Pines Elementary where CAM was first introduced in math and Chart 4 is for Northeast Elementary where CAM was first introduced in reading. Although no research design nor statistical tests were applied in these cases, very interesting spurts of growth are noted for the children participating in the CAM system relative to when the system was introduced.



TWIN PINES ELEMENTARY SCHOOL



NORTHEAST ELEMENTARY SCHOOL

CHART 5 (handout) is a comparison of the mean scores from the sixth grade NYS PEP Math Test between two groups. One group is comprised of children in the three ESEA target schools that first received CAM. The other group is comprised of the children in the other eleven schools in the District which have not used CAM during the time of the comparison. The progress of the CAM schools counters the New York State downward trend in sixth grade mathematics scores as reported on page 11 of the Statewide Report of October 1973 Reading and Mathematics Test Results. The non-CAM schools mean math scores are also following a pattern similar to that of the state as a whole. Trends such as these provide substantial evidence that the CAM system in Brentwood is an effective tool for use in helping children acquire mathematics skills.

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

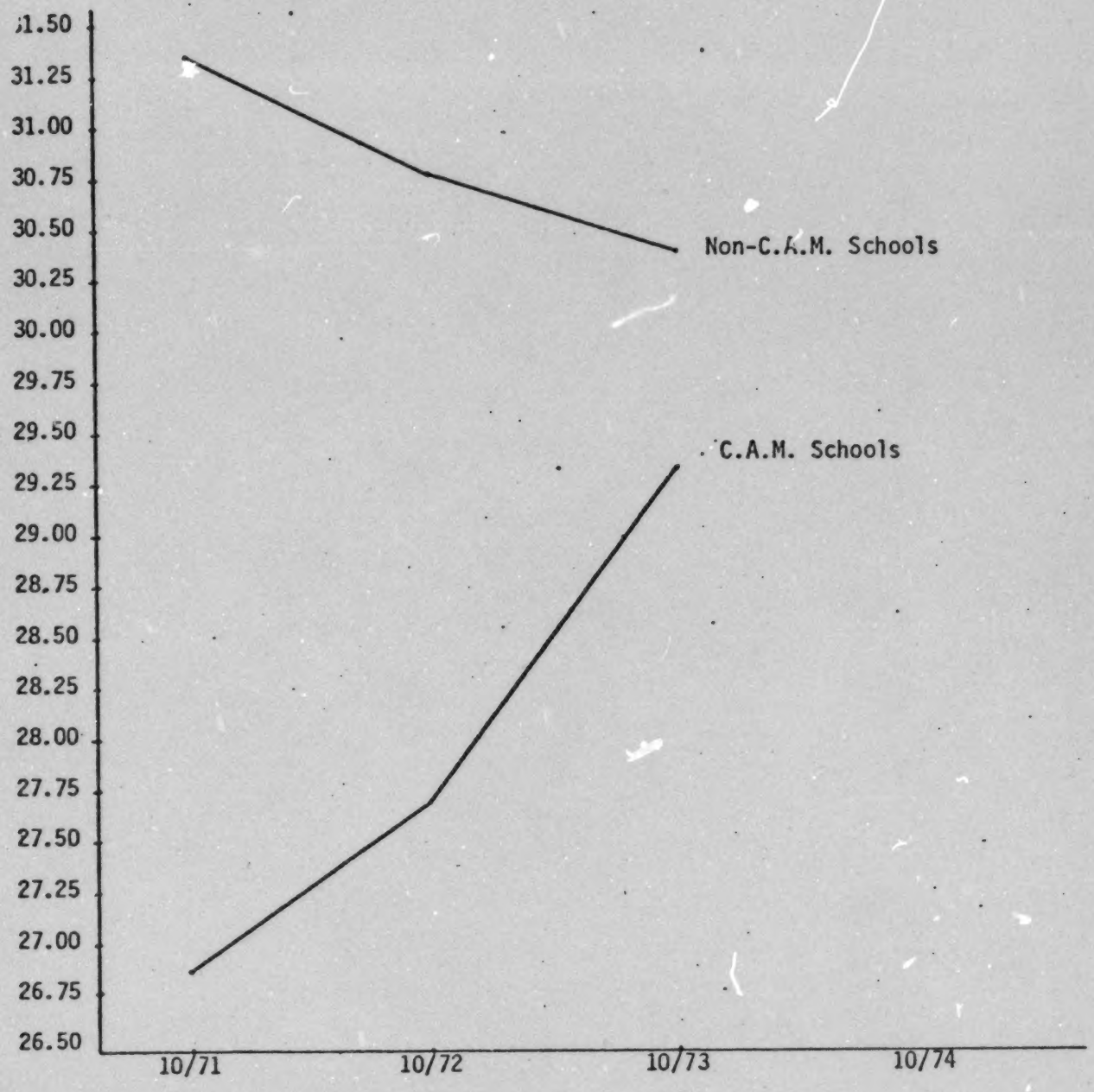


FIGURE 1:

Mean Score Comparisons on Three Administrations of the Sixth Grade N.Y.S. P.E.P. Math Test of Three E.S.E.A. Target Schools using C.A.M. in Math to the other Eleven Schools in Brentwood not using the C.A.M. system.

CONCLUSION

An information system that gives regular reports on achievement and retention helps both the learner and the teacher. The CAM information system does not prescribe materials or methods but requires frequent teacher decisions concerning strategy and tactics to help students achieve.

Brentwood's three year results on a variety of tests support the idea that specifying tasks and testing performance will improve the student's performance in reading and math for grades 4, 5, and 6.

Observing students behavior on these specified tasks seems more appropriate than measuring against a norm which sorts all learners into above and below percentiles or stanines.

The Product Evaluation submitted to the Klepak Commission used norm-referenced tests for comparison. If we really believe in criterion referenced tests, the analysis of objectives and performance used in evaluating a program should measure student growth against the original criterion. Mr. David Holt has compiled the following report on our student's progress toward the set of objectives for each level. Overwhelmingly there is positive growth. Where there is not, the math committee will study the situation to bring about one of the following:

1. better student performance
2. change in the objectives
3. change in test items
4. change in method or material for instruction.

The evaluation of the program to this point has encouraged the decision to monitor reading and mathematics in the junior high schools as well, beginning in 1975-76.

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

TO: Arthur R. Brieger

FROM: David S. Holt

RE: BEST MATH ANALYSIS OF OBJECTIVE PROGRESS DURING THE 1973-1974 SCHOOL YEAR

DATE: April 9, 1975

At the request of Mr. Fournier, I conducted an analysis of the BEST Math progress during the 1973-74 school year.

Attached are several tables that examine the progress of children in achieving success on each objective within each math level. This is the first comprehensive view of math achievement shown in terms of the criterion referenced test scores for a full year period. The results of the analysis are very interesting; they show important positive changes; they should be very useful to the BEST Math Revision Committee.

The first table in each level is a frequency distribution of the percent correct for each objective on the first test pre-instructional and of the percent correct for each objective on the last test post-instructional. This table shows the median percent correct for all objectives pre-instructional, for all objectives post-instructional and for the increase in median percent correct. It also shows the range of percent correct for the objectives on the first test and on the last test. It will be noted that in all three levels the range narrows considerably as the median percent correct is raised. These two bits of information show that the pupil's progress has the pattern expected when teachers utilize the procedure of teaching for achievement of behavioral objectives and those objectives are measured with a criterion referenced test.

The second table provides data on individual objectives. The first column lists in which semester the objective was taught and the second column lists the percent correct of the items for each objective on the first test prior to instruction. The next column indicates the percent correct of the items for each objective on the last test of the semester, while the fourth column lists the increase in percent correct, i.e., column three minus column two. Column five lists the percent correct of the items for the objectives taught both semesters, and the next column lists the increase in percent correct, i.e., column five minus column two. The data in column four also have plus signs (+) beside the increases that are above the median for the group of objectives. Those objectives above the median increase are verbally identified in the last column.

The last table presents the frequency of increases in percent correct for all objectives for only one semester and for both semesters.

These data summaries will help the review committee make decisions about which objectives to keep and which objectives need revision. I would be glad to explain these tables in person if you felt it would be helpful.

DSH:cb
cc: Mr. DiPietro
Mr. Fournier

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 4 - BEST MATH

	Frequency of % Right Pre-Instructional			Frequency of % Right Post-Instructional		
	t	f	cf	t	f	cf
96-100						
91- 95						
86- 90				111	3	42
81- 85				1111	4	39
76- 80	1	1	42	111	3	35
71- 75				1111	4	32
66- 70				1111 111	8	28
61- 65	11	2	41			(Median = 66.1)
56- 60				1111	5	20
51- 55	1111	5	39	1111 11	7	15
46- 50	1111 111	8	34	1111	4	8
41- 45	1111 1111 1	11	26	111	3	4
	(Median = 43.2)					
36- 40	1	1	15	1	1	1
31- 35	1111	4	14			
26- 30	111	3	10			
21- 25	111	3	7			
16- 20	1111	4	4			
11- 15						
6- 10						
1- 5						

Range = 64

Range = 54

Difference between medians is 22.9

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 4 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
411	1	46	64	18			
413	1	34	56	22			
414	2	43	59	16			
415	1	43	56	13			
416	2	25	37	12			
417	2	20	53	33 +			Common Factors
418	2	50	69	19			
421	1	64	83	19			
422	1	53	71	17			
423	1	39	76	37 +			Multiplicatio
424	1,2	19	46	27 +	52	33	Division
425	2	49	66	17			
426	2	41	69	28 +			Multiplicatio
427	2	25	57	32 +			Division
431	2	26	48	22			
432	2	35	68	33 +			Equivalent Fractions
433	2	20	46	26 +			Mixed Numbers
434	2	45	86	41 +			Add Fractions w/= Denom.
435	2	55	84	29 +			Subtract Frac w/= Denom.
436	2	34	48	14			
437	1,2	24	55	31 +	64	40	Equivalent Fractions
451	1,2	43	60	17	71	28	

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BRENTWOOD, NEW YORK

GRADE 4 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
452	1,2	41	68	27 +	77	36	Basic operations w/number sent
453	2	45	82	37 +			Number sent w/Fractions
461	1,2	55	69	14	73	18	
462	1	49	60	11			
463	1	52	63	11			
464	1,2	49	68	19	81	32	
465	1,2	43	71	28 +	72	29	Division word Problems
466	2	31	56	25 +			+, - word pro w/fractions
467	1	48	61	13			
468	1,2	64	91	27 +	90	26	Reading graph
469	2	44	64	20			
4610	2	27	55	28 +			Division word problems
471	1	19	60	41 +			English linea measure w/ +
472	1	46	70	24 +			Precision of lin.measureme
473	2	50	66	16			
474	2	42	69	27 +			English measu w/Add.& Subtr
475	2	44	70	26 +			Time measure
476	2	29	55	26 +			English linea measure w/ -
482	2	54	79	25 +			Identify 3D figures
483	2	76	90	14			

BRENTWOOD UNION FREE SCHOOL DISTRICT
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GRADE 4 - BEST MATH

Increase in % Right	Objective Frequency Distribution — One Semester t	f	cf	Both Semesters t	f	cf	
56-60							
51-55							
46-50							
41-45	11	2	42				
46-40	11	2	40	11	2	8	
31-35	1111	4	38	11	2	6	
26-30	~~1111~~ ~~1111~~ 1	11	34	111	3	4	30.5 Median
21-25	~~1111~~	5	23				
16-20	23.5 Median ~~1111~~ ~~1111~~	10	18	1	1	1	
11-15	~~1111~~ 111	8	8				
6-10							
1-5							

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 5 - BEST MATH

	Frequency of % Right Pre-Instructional			Frequency of % Right Post-Instructional		
	t	f	cf	t	f	cf
96-100						
91- 95				1	1	58
86- 90				11	2	57
81- 85	1	1	58	11	2	55
76- 80	1	1	57	~~1111~~ 11	7	53
71- 75				~~1111~~ 111	8	46
66- 70	111	3	56	~~1111~~ 1111	9	38
61- 65	1111	4	53	~~1111~~ ~~1111~~ 11	12	29
56- 60	111	3	49	~~1111~~ ~~1111~~	10	17
51- 55	1	1	46	~~1111~~	5	7
46- 50	~~1111~~	5	45			
41- 45	~~1111~~ 11	7	40	1	1	2
36- 40	111	3	33	1	1	1
31- 35	111	3	30			
	(Median = 33.8)					
26- 30	~~1111~~ ~~1111~~ 11	13	27			
21- 25	~~1111~~ 11	7	14			
16- 20	1111	4	7			
11- 15	1	1	3			
6- 10	11	2	2			
1- 5						

(Median = 65.5)

Range = 79

Range = 59

Difference between medians is 31.7

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 5 - BEST MATH

Objective Number	Semester Taught	Test 1 % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
511	1	68	75	8			
513	1	60	67	7			
514	1	25	65	40 +			Rounding to 1,000
515	2	28	41	13			
516	2	30	51	21			
517	2	38	63	25			
518	2	43	68	25			
519	2	61	75	14			
521	1	82	86	4			
522	1	70	82	12			
523	1,2	46	76	30 +	66	20	Multiply two 3-digit nos.
524	1,2	35	65	30 +	56	19	Division of 5-digits by 2 gits w/remainder
531	2	36	63	27			
532	2	33	64	31 +			Least common denominator
533	2	22	60	38 +			Adding fract. w/unlike denominators
534	2	16	55	39 +			Subtract frac w/unlike denominators
535	2	17	58	41 +			Multiply whol # and a fract
536	2	52	74	22			
537	2	26	63	37 +			Add mixed # w/unlike denominators
538	2	28	62	34 +			Subtr. mixed # w/unlike denominators

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 5 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
539	2	39	64	25			
5310	2	27	57	30 +			Subtr. mixed # w/unlike denominators
5311	2	18	57	39 +			Division of fractions
541	2	27	80	53 +			Changing frac to decimals
542	2	42	77	35 +			Changing dec. to fractions
543	2	19	57	38 +			Adding decima
544	2	63	74	11			
545	2	10	52	42 +			Place value for decimals
551	1	25	52	27			
552	1	28	66	13			
553	1	23	63	40 +			Associative prop. of multiplicatic
554	1	27	72	45 +			Commutative prop. of multiplicatic
555	1,2	48	75	27	69	21	
556	1,2	47	67	20	65	18	
557	2	45	74	29 +			Missing frac # facts in # sentences
558	2	49	68	19			
561	1,2	33	44	11	54	21	
562	1	78	89	11			
563	1	58	74	16			
564	1,2	47	66	19	70	23	

BRENTWOOD UNION FREE SCHOOL DISTRICT
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GRADE 5 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
565	1,2	43	73	20	64	21	
566	2	22	59	37 +			Word problems w/add.or subt fractions
567	1,2	41	60	19	70	29	
568	1	63	80	17			
569	1,2	26	71	45 +	60	34	Averages
571	1	27	56	29 +			English linea measure w/add & subtraction
572	1,2	60	83	23	85	25	
575	1	27	60	33 +			English liqui measure w/add & Subtraction
576	1	27	61	34 +			English weig measure w/adc & subtractior
577	1	30	72	42 +			Time measure w/addition & subtraction
578	1	66	79	13			
581	1	63	92	29 +			Finding perimeter
582	1,2	11	62	51 +	64	53	Area of rectangle
583	2	9	36	9			
585	1	41	78	37 +			Properties o line segments
586	1	24	77	53 +			Classificati of angles
587	1	21	76	55 +			Measurement of angles
588	2	41	69	28			

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 5 - BEST MATH

Increase in % Right	Objective Frequency Distribution					
	One Semester			Both Semesters		
	t	f	cf	t	f	cf
56-60						
51-55	1111	4	58	1	1	11
46-50						
41-45	~~1111~~	5	54			
36-40	~~1111~~ 1111	9	49			
31-35	~~1111~~	5	40	1	1	10
26-30	~~1111~~ ~~1111~~ Median 27.5	10	35	1	1	9
21-25	~~1111~~ 1	6	25	~~1111~~	5	8
16-20	~~1111~~ 11	7	19	111	3	3 23.0 Median
11-15	~~1111~~ 111	8	12			
6-10	111	3	4			
1- 5	1	1	1			

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 6 - BEST MATH

	Frequency of % Right Pre-Instructional			Frequency of % Right Post-Instructional		
	t	f	cf	t	f	cf
96-100						
91- 95				1	1	54
86- 90	1	1	54	111	3	53
81- 85	1	1	53	111	3	50
76- 80	11	2	52	1111	4	47
71- 75				~~1111~~ 1	6	43
66- 70	111	3	50	~~1111~~ 111	8	37
61- 65				~~1111~~ 1111	9	29 (Median = 64.4)
56- 60	11	2	47	~~1111~~ ~~1111~~ 11	12	20
51- 55	1111	4	45	1111	4	8
46- 50	1111	4	41	111	3	4
41- 45	111	3	37	1	1	1
36- 40	~~1111~~ 1	6	34			
31- 35	~~1111~~ 1	6	28 (Median = 34.7)			
26- 30	~~1111~~ ~~1111~~ 11	12	22			
21- 25	~~1111~~	5	10			
16- 20	1111	4	5			
11- 15	1	1	1			
6- 10						
1- 5						

Range = 79

Range = 50

Difference between medians is 30

BRENTWOOD UNION FREE SCHOOL DISTRICT
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GRADE 6 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
611	2	24	59	35 +			Scientific Notation
613	1	18	45	27			
614	2	25	61	36 +			Rounding to nearest decimal fraction
615	2	29	59	30 +			Decimal inequalities
616	1,2	57	79	22	79	22	
617	1,2	53	70	17	68	15	
618	1	35	62	27			
619	2	41	59	18			
621	1	86	91	5			
622	1	84	88	4			
623	1	68	78	10			
624	1,2	47	63	16	62	15	
631	1,2	36	58	22	58	22	
632	1,2	27	59	32 +	62	35	+ Fractions w/ unlike denominators
633	1,2	28	69	41 +	63	35	- Fractions w/ unlike denominators
634	1,2	19	61	42 +	59	40	Multiplication of Fractions
635	1,2	30	71	41 +	65	35	Division of Fractions
636	1,2	31	57	26	55	24	
637	1,2	22	62	40 +	53	31	- Fractions w/ unlike denominators

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 6 - BEST MATH

Objective Number	Semester Taught	Test I % Right Pre-Instructional	Test 6 % Right Post-Instructional	Increase in % Right	Test 12 % Right Post-Instructional	Increase in % Right	Objective Description
638	1,2	47	75	28 +	72	25	Multiplication of Fractions
639	1,2	42	70	28 +	70	28	Division of Fractions
641	1,2	20	72	52 +	66	46	Place value for decimals through 10,000ths
642	1,2	46	79	33 +	72	26	Reading & writing decimals through 10,000ths
643	2	30	58	28 +			Changing Fraction to decimals
644	2	29	46	17			
645	2	77	84	7			
646	2	40	60	20			
647	2	28	60	32 +			Division of decimals through hundredths
648	2	27	52	25			
651	2	23	67	44 +			Changing ratio to percent
652	2	29	59	30 +			Finding Percent of natural no.
653	2	19	60	41 +			Finding what % one no. is of another
654	1	49	77	28 +			Finding average of whole no.
661	1	55	71	16			
662	1,2	28	36	8	50	22	
663	2	43	58	15			
664	1	56	71	15			

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 6 - BEST MATH

Objective Number	Semester Taught	Test 1 % Right Pre-In-structional	Test 6 % Right Post-In-structional	Increase in % Right	Test 12 % Right Post-In-structional	Increase in % Right	Objective Description
665	2	25	55	30 +			Word problems w/ percent
666	1	76	88	12			
667	2	28	69	41 +			Proportions w/one unknown in no. sentence
668	2	37	56	19			
671	1	39	69	30 +			English linear measure
672	1	38	62	24			
673	1,2	35	71	36 +	77	42	Metric system internal conversion
675	1,2	26	64	38 +	61	35	English liquid measure w/+ or -
676	1	35	63	28 +			English weight measure w/+ or -
677	1	35	67	32 +			Time measure w/+ or -
681	1	68	90	22			
682	1	51	81	30 +			Finding area of rectangle
683	2	13	47	34 +			Finding surface area of rectangular prism
684	1	53	82	29 +			Straight line segment properti
685	1,2	36	76	40 +	68	32	Naming and measuring angles
686	1	67	75	8			
687	1,2	35	81	46 +	71	36	Naming parts of circles & measuring arcs.

BRENTWOOD UNION FREE SCHOOL DISTRICT
BRENTWOOD, NEW YORK

GRADE 6 - BEST MATH

Objective Frequency Distribution

Increase in % Right	One Semester t	f	cf	Both Semesters t	f	cf	
56-60							
51-55	1	1	54				
46-50	1	1	53	1	1	19	
41-45	~~1111~~ 1	6	52	1	1	18	
36-40	~~1111~~	5	46	11	2	17	
31-35	~~1111~~ 1	6	41	~~1111~~ 1	6	15	30.92 Median
26-30	~~1111~~ ~~1111~~ 1111	14	35	11	2	9	
	27.64 Median						
21-25	~~1111~~	5	21	~~1111~~	5	7	
16-20	~~1111~~ 11	7	16				
11-15	111	3	9	11	2	2	
6-10	1111	4	6				
1- 5	11	2	2				

X. Budget.

A. Financial Budget

1. Start-up Cost - 1st year

a. 25% per student charge by Grumman Data System for 1100 students. ESEA funded.	$ 275.00
b. $500.00 per team leader for extra services.	1500.00
c. Three principals X 3 weeks salary for workshop and writing.	5400.00
d. Three teachers X 3 weeks salary for workshop and writing	3600.00
Total Start-up Costs.....	$10,775.00

2. Current Costs

a. 9¢ per student per test processed by Brentwood Computer.

b. Twelve Math team leaders at $500.00.

c. Net cost to district for writing (summer '75) Junior High objectives in math and rewriting elementary math and reading. Total Cost is $20,000.00 but through BOCES Cooperative Aid Project, 80% (district aid ratio) is reimbursable.

d. Twelve Aides X 3 hours per week.

B. Time Commitment

The Curriculum Coordinator has given up to 40% of his time in some periods to the management of this project.

It has involved all teachers and administrators inestimably from a time point of view.

XI. Self Assessment. Luck had a great deal to do with the successful implementation of this program. I would like to believe that hard work had even more to do with it. I have been responsible for the development of educational programs in the school district since 1963. Many of our programs have achieved national distribution. BEST however, was the most complicated, needing more materials, people and strategy than any other.

Its scope is overwhelming in some regards. It comes at a time when behavioral objectives and accountability are controversial. It has done what it was supposed to do and yet it will never be finished. It continues to offer great hope for the organization of more effective instructional programs. It is modern in its use of technology and up-to-date management systems. Yet the potential for mis-use is significant. It must be watched because if it is mis-used, at best it would fail and disappear; at worst it has the potential to be used for oppression of students and faculty. This is probably true of all effective measures. Managers are usually caught in between doing nothing and doing some very positive things which have potential for mis-use. Just as we are not likely to give up books, radio, newspapers and television because they have the potential to be mis-used, we will not pass up this fine tool for that same reason. This becomes just one more factor that requires professional vigilance.

Assessing my own performance in the program, I can't think of

much that I would change. If I were doing it again, I would like to have more money and a larger staff.

We once had a group of visitors from one of the school districts in New York City. (roughly the size of Brentwood) They were expending $300,000 in an attempt to implement this system. The project coordinator worked with the project as his one and only job. With a tiny fraction of that budget, with this a small part of my responsibility, there were times when it seemed very difficult.

Since the program is a success I wouldn't change any decision for fear that it would precipitate the development of some uncontrollable situation.

XII. Bibliography

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XIII. Appendix.

MATH

A. Printout from Computer

B. Manual for Parents and Students

C. Visitors Guide

D. Mastery Tests

E. Cross Reference Guides

F. Answer Keys

G. Objectives Printout (reading)

H. Math Tests - all levels

I. Student Update Printout List

J. Practice Book for Level 6 - Edward Harris

READING

K. Manual for Parents and Students

L. Cross Reference Guides

M. Objective Bank

N. Test Item Bank

O. Reading Tests - all levels

P. Answer Sheet

Q. Reading Manual for Visitors

R. Reading Mastery Tests

S. Mastery Answer Key